

LEGAL MYTHMAKING IN A TIME OF MASS EXTINCTIONS: RECONCILING STORIES OF ORIGINS WITH HUMAN DESTINY

*Jim Chen**

Biodiversity loss represents humanity's most urgent challenge. No other scientific problem, if left unsolved, will take longer to correct. A proper sense of natural history, spanning at a minimum the entirety of the Phanerozoic eon, informs us that human civilization represents the sixth major extinction event in the last 600 million years of geological history. At a practical level, American environmental law has two basic tools for forestalling the apocalyptic destruction of the biosphere. The National Environmental Policy Act and the Endangered Species Act as leading environmental "super-statutes" fulfill a legal function served by constitutional provisions in other countries. American leadership on environmental protection, particularly in the realm of biodiversity conservation, is threatened by the public's failure to understand evolution, natural history, and the significance of the ongoing crisis in biodiversity loss. Opinions by Justice Antonin Scalia in prominent Supreme Court controversies over the teaching of evolution give unjustified aid and comfort to advocates of ignorance in American politics. Justice Scalia's pandering undermines thoughtful efforts to invigorate American environmental law with a conservationist ethic. If human society wishes to retard, let alone reverse, its tragic record of spurring one of only six mass extinctions among complex life forms in the history of the planet, environmental law must embrace the scientifically validated history of the earth as its "story of origins."

This Essay asks two admittedly immodest questions. First, what is the most significant problem facing the world, at least within the range of problems conventionally addressed by environmental law? Second, what measures, both practical and symbolic, can the law take toward solving or at least alleviating that problem? The answers to these questions testify to the urgent need to incorporate an environmental ethic into core questions of human governance.¹

My thesis is simple: human civilization has changed the world beyond recovery within any time frame capable of being contemplated, let alone managed, by our species. The project of ameliorating humanity's environmental footprint demands humility, wonder, and above all a thorough scientific understanding of natural history and humanity's place in it. By design or by happenstance, human civilization has proceeded according to the aesthetic and political philosophy expressed by the early twentieth cen-

*Associate Dean for Faculty and James L. Krusemark Professor of Law, University of Minnesota Law School. Jason Adkins, Glenn Branch (of the National Center for Science Education), Daniel A. Farber, Alexandra Glynn, Gil Grantmore, Jamie A. Grodsky, Kristin Hickman, Owen D. Jones, Bradley C. Karkkainen, and Bernard M. Lewinson provided helpful comments. Jenny Hanson and Marci Windsheimer supplied very capable research assistance. Special thanks to Kathleen Chen.

¹Though this Essay can hardly respond to the full range of issues raised by Holly Doremus, *Constitutive Law and Environmental Policy*, 22 STAN. ENVTL. L.J. 295 (2003) and William E. Scheuerman, *Constitutionalism in an Age of Speed*, 19 CONST. COMMENT. 353 (2002), it does represent an embryonic effort to synthesize some of my reactions to those excellent articles.

tury's Futurist movement.² "[T]he world's magnificence has been enriched by a new beauty," proclaimed the *Futurist Manifesto* in 1909, "the beauty of speed."³ Contemporary industrialized societies have affirmatively embraced "[s]peed [as] the form of ecstasy the technical revolution has bestowed on man."⁴ But human society must now pay a profound, perhaps unbearable price. "A law of acceleration, definite and constant as any law of mechanics, cannot be supposed to relax its energy to suit the convenience of man."⁵ Contemporary life having embraced the Futurists' "love of danger" and their "habit of energy and fearlessness," we shall "like young lions . . . r[u]n after Death, its dark pelt blotched with pale crosses as it escape[s] down the vast violet living and throbbing sky."⁶ Civilization's ravenous appetite for natural resources has reached epic proportions, almost surely beyond the earth's carrying capacity. Humanity's contribution to the acceleration of natural history has thus triggered a correlative, awful responsibility: that of managing "omnipresent speed" on "the last promontories of the centuries."⁷

I. APOCALYPSE NOW

Environmental ethics in Western society has never quite shaken the influence of the Judeo-Christian religious tradition.⁸ One prominent critic has traced the "roots of our ecological crisis"⁹ to the Book of Genesis' directive to "subdue" the earth and to "have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth."¹⁰ A more

² See generally CINZIA SARTINI BLUM, *THE OTHER MODERNISM: F. T. MARINETTI'S FUTURIST FICTION OF POWER* (1996); STEPHEN KERN, *THE CULTURE OF TIME AND SPACE, 1880-1918*, at 119-23 (1983).

³ Filippo Tommaso Marinetti, *The Founding and Manifesto of Futurism*, LE FIGARO, Feb. 20, 1909, reprinted in *FUTURIST MANIFESTOS* 19, 21 (Umbro Apollonio ed. & Robert Brain et al. trans., 1970); cf. MICHAEL L. DERTOUZOS, *WHAT WILL BE: HOW THE NEW WORLD OF INFORMATION WILL CHANGE OUR LIVES* 9 (1997) (predicting that the ongoing "Information Revolution will trigger a . . . sweeping transformation" of our lives, mostly for the better).

⁴ MILAN KUNDERA, *SLOWNESS 2* (Linda Asher trans., 1996).

⁵ HENRY ADAMS, *THE EDUCATION OF HENRY ADAMS* 493 (Modern Library, 1996).

⁶ Marinetti, *supra* note 3, at 20-21.

⁷ *Id.* at 21-22.

⁸ See generally DAVID R. KINSLEY, *ECOLOGY AND RELIGION* (1995); J. BAIRD CALLICOTT, *EARTH'S INSIGHTS: A MULTICULTURAL SURVEY OF ECOLOGICAL ETHICS FROM THE MEDITERRANEAN BASIN TO THE AUSTRALIAN OUTBACK* 14 (1994) (identifying the "[h]istorical [r]oots of Western European [e]nvironmental [a]ttitudes and [v]alues"); JOHN PASSMORE, *MAN'S RESPONSIBILITY FOR NATURE* (1974); Jim Chen, *Of Agriculture's First Disobedience and Its Fruit*, 48 VAND. L. REV. 1261 (1995); Jim Chen, *Webs of Life: Biodiversity Conservation as a Species of Information Policy*, 89 IOWA L. REV. 495, 598-602 (2004); cf. Judith Green, *Retrieving the Human Place in Nature*, 17 ENVTL. ETHICS 381, 389-93 (1995) (discussing the impact of Aristotelian philosophy on contemporary environmental ethics).

⁹ Lynn White, *The Historical Roots of Our Ecological Crisis*, 155 SCI. 1203, 1205 (1967).

¹⁰ *Genesis* 1:28. All biblical citations refer to the Revised Standard Version.

sympathetic treatment of the Judeo-Christian tradition describes the story of Noah and the Great Flood as a basis for advocating biodiversity conservation.¹¹ Campaigns on behalf of more aggressive protection of biodiversity routinely embrace religious rhetoric and describe the conservationist mission in spiritual terms. As some prominent biologists have described their task, efforts “to preserve an ecosystem and its component species” should “proceed as if each species is sacred.”¹²

Legal disputes over religious influence in the teaching of biology and natural history, however, almost never identify the biblical passage that comes closer than any other to accurately depicting evolution. “[T]he race is not to the swift,” said the Preacher, “nor the battle to the strong . . . but time and chance happen to them all.”¹³ In stark contrast with the vulgar and misleading depiction of evolution as “survival of the fittest,”¹⁴ contemporary biology has deepened its appreciation of “extinction through bad luck” as an “element [of] the evolutionary process.”¹⁵ Biologically speaking, dominance today can dissolve into extinction tomorrow.¹⁶ Humanity should not “equate transient domination with either intrinsic superiority or prospects for extended survival.”¹⁷

Eventually luck runs out. In the long run nearly all species become extinct (“only about one in a thousand” among the “between five and fifty billion species [that] have existed at one time or another” still exists “—a truly lousy survival record” of “99.9 percent failure”).¹⁸ Mortality is “the fatal flaw . . . which Nature, in one shape or another, stamps ineffaceably on all her productions, either to imply that they are temporary and finite, or that their [survival] must be wrought by toil and pain.”¹⁹ By ecological and evo-

¹¹ See John Copeland Nagle, *Playing Noah*, 82 MINN. L. REV. 1171 (1998).

¹² Kevin Shear McCann, *The Diversity-Stability Debate*, 405 NATURE 228, 233 (2000) (describing this approach to biodiversity policy as “obvious”).

¹³ *Ecclesiastes* 9:11.

¹⁴ See, e.g., HERBERT SPENCER, 1 THE PRINCIPLES OF BIOLOGY 457 (1897); Herbert Spencer, *A Theory of Population, Deduced from the General Law of Animal Fertility*, 57 THE WESTMINSTER & FOREIGN Q. REV. 468, 499–500 (1852); cf. JULIAN HUXLEY, EVOLUTION: THE MODERN SYNTHESIS 564–65 (1942) (characterizing so-called “progress” in evolution as “increased control over and independence of the environment”). The literature on the misguided application of evolutionary principles in the social sciences is enormous. One starting point would be RICHARD HOFSTADTER, SOCIAL DARWINISM IN AMERICAN THOUGHT (1992).

¹⁵ See DAVID M. RAUP, EXTINCTION: BAD GENES OR BAD LUCK? 192 (1991).

¹⁶ See David Tilman et al., *Habitat Destruction and the Extinction Debt*, 371 NATURE 65 (1994) (describing how dominant species actually face a higher risk of extinction in the wake of habitat destruction because they have invested more in competition on a geographically circumscribed scale relative to colonization of a broader range).

¹⁷ STEPHEN JAY GOULD, FULL HOUSE: THE SPREAD OF EXCELLENCE FROM PLATO TO DARWIN 73 (1996); see also *id.* at 19–21 (arguing that diversity in life forms, not complexity as such, is the true hallmark of evolutionary success).

¹⁸ RAUP, *supra* note 15, at 3–4; cf. JOHN MAYNARD KEYNES, A TRACT ON MONETARY REFORM 80 (1923) (“In the long run we are all dead.”).

¹⁹ NATHANIEL HAWTHORNE, *The Birthmark*, in HAWTHORNE SELECTED TALES AND SKETCHES 264, 266 (3d ed. 1970). Hawthorne’s story speaks of “perfection . . . wrought by toil and pain,” not merely of survival. *Id.* (emphasis added).

lutionary standards, *Homo sapiens sapiens* has succeeded spectacularly. As “large fierce animals,” we humans should be “astonishingly . . . rare.”²⁰ At one point in human history, “[w]e were rare, as all large fierce animals are rare.”²¹ But we are no longer rare, and our biological good fortune has weakened almost every other strand in the web of life. Humans now consume 20% to 40% of the solar energy captured by plants.²² Humanity currently claims 54% of earth’s available fresh water, and that thirst is projected to increase to 70% by 2050.²³ Indeed, “the world’s average human eco-footprint is about 2.3 [hectares, or 5.7 acres], even though there are only 1.9 [hectares, or 4.7 acres] of productive land and water per person on Earth.”²⁴

This claim on earth’s resources comes at the expense of almost every other form of life.²⁵ In 1991, naturalist Jared Diamond predicted that “half the world’s species will be extinct or on the verge of extinction” by the end of the twenty-first century.²⁶ Estimates of the proportion of plant species worldwide threatened with extinction range from 13% to 50%.²⁷ The death toll from rainforest destruction alone “might easily reach 20% by 2022 and rise as high as 50% or more thereafter.”²⁸ Sources predict anywhere between 0.6% and 30% of biodiversity loss per decade, with most estimates falling between 1% and 10%.²⁹ Under even a “conservative estimate” that attributes extinction solely to rainforest destruction, 27,000 species are lost every year, or roughly three every hour.³⁰ These losses, of

²⁰ PAUL COLINVAUX, WHY BIG FIERCE ANIMALS ARE RARE: AN ECOLOGIST’S PERSPECTIVE 27 (1978) (“[T]here are not fiercer dragons on the earth than there are . . . because the energy supply will not stretch to the support of super-dragons.”).

²¹ *Id.* at 214 (emphases added).

²² EDWARD O. WILSON, THE DIVERSITY OF LIFE 272 (1992); cf. Peter M. Vitousek et al., *Human Appropriation of the Products of Photosynthesis*, 36 *BIOSCI.* 368, 372 (1986) (reporting that humans co-opt approximately 40% of net primary production in terrestrial ecosystems and 25% of global net primary production, including photosynthesis in the oceans).

²³ See Sandra L. Postel et al., *Human Appropriation of Renewable Fresh Water*, 271 *SCI.* 785, 787 (1996).

²⁴ William E. Rees, *A Blot on the Land*, 421 *NATURE* 898, 898 (2003) (summarizing WORLDWIDE FUND FOR NATURE, *LIVING PLANET REPORT 2002* 4 (2002)). For a discussion of the concept of an ecological footprint as a method for estimating the aggregate land and water area appropriated for human consumption and waste disposal, see NEIL A. CAMPBELL & JANE B. REECE, *BIOLOGY* 1170–71, glossary (6th ed. 2002).

²⁵ See generally Peter M. Vitousek et al., *Human Domination of Earth’s Ecosystems*, 277 *SCI.* 494 (1997).

²⁶ Jared Diamond, *World of the Living Dead*, 100 *NATURAL HIST.* 30, 30 (1991).

²⁷ See Nigel C. A. Pitman & Peter M. Jorgensen, *Estimating the Size of the World’s Threatened Flora*, 298 *SCI.* 989 (2002).

²⁸ WILSON, *supra* note 22, at 278; see also JEFFREY A. MCNEELY ET AL., *CONSERVING THE WORLD’S BIOLOGICAL DIVERSITY* 41 (1990) (estimating a risk of a 25% loss in total biological diversity by 2010 or 2020).

²⁹ See Nigel E. Stork, *The Magnitude of Global Biodiversity and Its Decline*, in *THE LIVING PLANET IN CRISIS: BIODIVERSITY SCIENCE AND POLICY* 3, 24 (Joel Cracraft & Francesca T. Grifo eds., 1999).

³⁰ See WILSON, *supra* note 22, at 280.

course, are permanent and incommensurable. As Thomas Gray expressed the sentiment in one of English literature's classic poems, "Full many a flower is born to blush unseen / And waste its sweetness on the desert air."³¹ Lucinda Williams expresses the same sense of loss in more contemporary language: "Money can't replace it / No memory can erase it / And I know I'm never gonna find / Another one to compare."³²

Stemming biodiversity loss arguably represents humanity's most urgent challenge. If the relevant gauge is the duration and difficulty of corrective measures, then human society faces no "scientific problem of greater immediate importance."³³ According to the geological record of previous extinction spasms, fully restoring biodiversity after a catastrophe such as a meteor strike requires between 10 and 100 million years.³⁴ By this measure, "the loss of genetic and species diversity by the destruction of natural habitats" is probably the contemporary crisis "our descendants [will] most regret" and "are least likely to forgive."³⁵

The staggering sweep of geological time and the sheer extent of life on earth demand careful consideration of the evolutionary implications of legal decisions. Measuring extinction rates on a geological timescale dramatically heightens the sense of crisis. An examination of the fossil record since the beginning of the Cambrian period, 590 million years ago, reveals an estimated average extinction rate of 9% per million years, or roughly one species every five years in a biosphere containing 2 million species.³⁶ Because paleontologists have trouble detecting extinctions among "local endemic species," taking these losses into account would increase the background extinction rate by "a factor of 10."³⁷ We may therefore assume a "background" extinction rate, as it were, of two species per year. An extremely conservative estimate of the human impact on extinction rates is two or

³¹ Thomas Gray, *Elegy Written in a Country Church-Yard* 14 (Raven Press ed., 1938) (1751); see also Robert Herrick, *To the Virgins to Make Much of Time*, in *THE LOVE POEMS OF ROBERT HERRICK AND JOHN DONNE* 13, 13 (Louis Untermeyer ed., 1948) ("And this same flower that smiles today, / Tomorrow will be dying.").

³² LUCINDA WILLIAMS, *I Lost It*, on *CAR WHEELS ON A GRAVEL ROAD* (Mercury Records 1998).

³³ WILSON, *supra* note 22, at 254.

³⁴ *Id.* at 330.

³⁵ *Endangered Species Act Oversight, Hearings Before the Subcomm. on Envtl. Pollution of the Senate Comm. on Env't and Pub. Works*, 97th Cong. 366 (1981) (statement of Edward O. Wilson).

³⁶ See David M. Raup, *Cohort Analysis of Generic Survivorship*, 4 *PALEOBIOLOGY* 1, 10 (1978).

³⁷ David M. Raup, *Diversity Crises in the Geological Past*, in *BIODIVERSITY*, at 51, 54 (E. O. Wilson ed., 1988); see also Werner Greuter, *Extinctions in Mediterranean Areas*, in *EXTINCTION RATES* 88, 92 (John H. Lawton & Robert M. May eds., 1995) (discussing limits on the calculation of extinction rates and the adoption of conservative assumptions in response to those limits). Local endemic species exist in a single, limited place. The limits on such species' range increases the probability that their fossils will escape detection by paleontologists. See ELDRA P. SOLOMON ET AL., *BIOLOGY* 1227 (6th ed. 2002).

three orders of magnitude greater—that is, species are dying off 100 to 1,000 times faster than they did in prehuman times.³⁸

Another way to visualize the contemporary extinction rate is to compare it with the rate at which new species emerge. One such estimate describes the current extinction rate as a million times faster than the speciation rate—an eye-popping difference of six orders of magnitude.³⁹ “Were speciation rates plotted as the *y*-axis on a graph 10 cm high, then on the same scale extinction rates would require an *x*-axis extending 100 km.”⁴⁰ In the folk idiom of traditional English measurements, a graph showing speciation rates on a one-inch scale would need to be roughly sixteen miles long to show extinction rates.

Paleontologists have rated the five most severe mass extinction events during the Phanerozoic eon of geological history, the last 570 million years of natural history putatively distinguished by “visible life.”⁴¹ Mass extinctions marked the end of the Ordovician, Devonian, Permian, Triassic, and Cretaceous periods.⁴² Each of these events left at least some evidence of an extraterrestrial cause for mass extinction, with perhaps the most famous of these events taking place 65 million years ago. What paleontologists call the Cretaceous-Tertiary (“K-T”) boundary is popularly known to most nonscientists as the twilight of the dinosaurs. The K-T boundary is marked by a substantial accumulation of iridium, a platinum group metal that is scarce on earth but abundant in extraterrestrial objects.⁴³ The father-and-son team of Luis and Walter Alvarez found a rich layer of iridium in numerous sites that marked the boundary between the Cretaceous and Tertiary periods, which suggested that a meteor strike triggered the spectacular loss of species 65 million years ago.⁴⁴ Though hotly disputed when it was first propounded in 1980, the Alverezes’ “impact theory” of K-T extinctions has won widespread acceptance.⁴⁵

³⁸ See Robert M. May et al., *Assessing Extinction Rates*, in *EXTINCTION RATES*, *supra* note 37, at 1, 13.

³⁹ See Robert M. May, *How Many Species Are There on Earth?*, 241 *SCI.* 1441, 1448 (1988).

⁴⁰ *Id.*

⁴¹ The Phanerozoic eon, named for the Greek words for “visible life,” comprises “the interval of time that represents the growth, development, and flourish[ing] of megascopic metazoans and metaphytes.” *THE ENCYCLOPEDIA OF PALEONTOLOGY* 321 (Rhodes W. Fairbridge & David Jablonski eds., 1979).

⁴² See generally A. HALLAM & P. B. WIGNALL, *MASS EXTINCTIONS AND THEIR AFTERMATH* (1997).

⁴³ See L. W. Alvarez et al., *Extraterrestrial Cause for the Cretaceous-Tertiary Extinction*, 208 *SCI.* 1095, 1095 (1980).

⁴⁴ See generally WALTER ALVAREZ, *T. REX AND THE CRATER OF DOOM* (1997); L. W. Alvarez et al., *supra* note 43.

⁴⁵ See, e.g., JAMES LAWRENCE POWELL, *NIGHT COMES TO THE CRETACEOUS* 221 (1998) (“As even its bitterest opponents have to admit, the Alvarez theory has brought geology not only a new set of questions, but also a greatly improved set of sampling techniques and analytical methods for answering them. . . . These are the hallmarks of a fertile theory.”). *But see* Michael E. Williams, *Catastrophic Versus Noncatastrophic Extinction of the Dinosaurs: Testing, Falsifiability, and the Burden of Proof*, 68 *J. PALEONTOLOGY* 183 (1994).

Gripped by the romance of the dinosaurs and their disappearance, popular culture has neglected the earlier and more spectacular extinction spasm at the end of the Permian period. The collapse of marine ecosystems 250–225 million years ago gave the world of complex organisms “an extremely close brush with total destruction.”⁴⁶ The end-Permian event is aptly described as “the greatest mass extinction of all time.”⁴⁷ This dramatic episode in natural history has attracted all sorts of hypotheses,⁴⁸ including runaway mutagenesis induced by cosmic radiation,⁴⁹ sea-level rise through continental fusion,⁵⁰ global *cooling* triggered by volcanic activity,⁵¹ global *warming* attributable to similar geological phenomena,⁵² and other catastrophic changes in the atmosphere, ranging from super-anoxia⁵³ to a “methane burp.”⁵⁴ As with the Cretaceous-Tertiary event, however, paleontologists are increasingly embracing an extraterrestrial explanation for the decimation of species at the close of the Permian.⁵⁵ The even older extinction event of the late Ordovician, 440 million years ago, may have resulted from a somewhat different source of extraterrestrial trauma: gamma ray bursts.⁵⁶ If correct, this hypothesis would link the late

⁴⁶ Raup, *supra* note 37, at 52; *see also* STEPHEN JAY GOULD, *EVER SINCE DARWIN: REFLECTIONS IN NATURAL HISTORY* 134 (1977) (describing the “great dying” of marine organisms “at the end of the Permian period” as “the most profound of several mass extinctions that have punctuated the evolution of life”). *See generally* D. H. Erwin, *The End-Permian Mass Extinction*, 21 *ANN. REV. ECOLOGY & SYSTEMATICS* 69 (1990).

⁴⁷ *See* MICHAEL J. BENTON, *WHEN LIFE NEARLY DIED: THE GREATEST MASS EXTINCTION OF ALL TIME* 9 (2003); *cf.* PETER DOUGLAS WARD, *GORGON: PALEONTOLOGY, OBSESSION, AND THE GREATEST CATASTROPHE IN EARTH’S HISTORY* 13 (2004).

⁴⁸ *See generally* BENTON, *supra* note 47, at 254–77.

⁴⁹ *See* Henk Visscher et al., *Environmental Mutagenesis During the End-Permian Ecological Crisis*, 101 *PROC. NAT’L ACAD. SCI.* 12,952 (2004).

⁵⁰ *See* Norman Newell, *Crises in the History of Life*, *SCI. AM.*, Feb. 1963, at 76, 91; James W. Valentine & Eldridge M. Moores, *Plate-Tectonic Regulation of Faunal Diversity and Sea Level: A Model*, 228 *NATURE* 657, 657 (1970).

⁵¹ *See* I. H. Campbell et al., *Synchronism of Siberian Traps and the Permian-Triassic Boundary*, 258 *SCI.* 1760 (1992); P. R. Renne et al., *Synchrony and Causal Relations Between Permian-Triassic Boundary Crises and Siberian Flood Volcanism*, 269 *SCI.* 1413 (1995).

⁵² *See* HALLAM & WIGNALL, *supra* note 42.

⁵³ *See* P. B. Wignall, *Extent and Duration of the Permo-Triassic Superanoxic Event, in CATASTROPHIC EVENTS & MASS EXTINCTIONS: IMPACTS AND BEYOND* 241 (2000).

⁵⁴ *See* Gerald R. Dickens et al., *Dissociation of Oceanic Methane Hydrate as a Cause of the Carbon Isotope Excursion at the End of the Paleocene*, 10 *PALEOCEANOGRAPHY* 965 (1995); Richard A. Kerr, *Climate Change: A Smoking Gun for an Ancient Methane Discharge*, 286 *SCI.* 1465 (1999); Quirin Schiermeier, *Rapid Climate Change: Gas Leak!*, 423 *NATURE* 681 (2003).

⁵⁵ *See* Asish R. Basu et al., *Chondritic Meteorite Fragments Associated with the Permian-Triassic Boundary in Antarctica*, 302 *SCI.* 1388 (2003); Luann Becker et al., *Impact Event at the Permian-Triassic Boundary: Evidence from Extraterrestrial Noble Gases in Fullerene*, 291 *SCI.* 1530 (2001).

⁵⁶ *See* A. L. Melott et al., *Did a Gamma-Ray Burst Initiate the Late Ordovician Mass Extinction?*, 3 *INT’L J. ASTROBIOLOGY* 55 (2004); *cf.* Robert L. Anstey et al., *Patterns of Bryozoan Endemism Through the Ordovician-Silurian Transition*, 29 *PALEOBIOLOGY* 305 (2003) (discussing the role of biogeography in the end-Ordovician extinction).

Ordovician with another episode of severe global cooling 600 million years ago, which in turn triggered the Cambrian explosion.⁵⁷

The Triassic extinction event is shrouded in mystery. Some studies suggest that terrestrial extinctions at the Triassic-Jurassic boundary resulted from a dramatic increase in atmospheric carbon dioxide, perhaps released by volcanic activity, and from the global warming that then ensued.⁵⁸ Competing explanations for the end-Triassic mass extinction dispute the volcanism hypothesis. Measurements from ancient soil samples suggest that the relatively negligible change in atmospheric carbon dioxide across the Triassic-Jurassic boundary could not have disturbed terrestrial plant and animal communities.⁵⁹ Although the available evidence does not conclusively attribute these extinctions either to bolide impact or to massive volcanism,⁶⁰ scientists have found another telltale iridium anomaly at the Triassic-Jurassic boundary.⁶¹

Among the five great mass extinction events of the Phanerozoic eon, that of the late Devonian period arguably bears the closest resemblance to contemporary extinctions.⁶² According to the “Devonian plant hypothesis,” the rapid spread of terrestrial plants during the Devonian not only caused the widespread eutrophication of shallow seas but also accelerated soil formation.⁶³ The resulting creation of calcium and magnesium carbonates removed carbon dioxide from the atmosphere and may have precipitated a sudden cooling of the earth and rampant glaciation.⁶⁴ If correct, the De-

⁵⁷ GABRIELLE WALKER, *SNOWBALL EARTH: THE STORY OF THE GREAT GLOBAL CATASTROPHE THAT SPAWNED LIFE AS WE KNOW IT* 203–04 (2003); see also Paul F. Hoffman et al., *A Neo-Proterozoic Snowball Earth*, 281 *SCI.* 1342 (1998); Richard A. Kerr, *An Appealing Snowball Earth That's Still Hard to Swallow*, 287 *SCI.* 1734 (2001); Richard A. Kerr, *Did an Ancient Deep Freeze Nearly Doom Life?*, 281 *SCI.* 1259 (1998). Gamma ray bursts separate nitrogen and oxygen molecules in the Earth's atmosphere. The resulting smog of nitrogen oxides would have cooled the Earth and triggered an ice age. See Melott et al., *supra* note 56, at 57–59. See generally Paul F. Hoffman & Daniel P. Schrag, *The Snowball Earth Hypothesis: Testing the Limits of Global Change*, 14 *TERRA NOVA* 129, 129 (2002); W. T. Hyde et al., *Neoproterozoic “Snowball Earth” Simulations with a Coupled Climate/Ice-Sheet Model*, 405 *NATURE* 425 (2000).

⁵⁸ See, e.g., Stephen P. Hesselbo et al., *Terrestrial and Marine Extinctions at the Triassic-Jurassic Boundary Synchronized with Major Carbon-Cycle Perturbation: A Link to Initiation of Massive Volcanism?*, 30 *GEOLOGY* 251, 253 (2002).

⁵⁹ See Lawrence H. Tanner et al., *Stability of Atmospheric CO₂ Levels Across the Triassic/Jurassic Boundary*, 411 *NATURE* 675 (2001).

⁶⁰ See A. Hallam et al., *Discussion on the Sea-Level Change and Facies Development Across Potential Triassic-Jurassic Boundary Horizons*, 161 *J. GEOLOGICAL SOC'Y, LONDON* 1053 (2004); J. C. McElwain et al., *Fossil Plants and Global Warming at the Triassic-Jurassic Boundary*, 285 *SCI.* 1386 (1999).

⁶¹ See P. E. Olsen et al., *Ascent of Dinosaurs Linked to an Iridium Anomaly at the Triassic-Jurassic Boundary*, 296 *SCI.* 1305 (2002).

⁶² See generally GEORGE R. MCGHEE, JR., *THE LATE DEVONIAN MASS EXTINCTION: THE FRASNIAN-FAMENNIAN CRISIS* (Columbia University, Critical Moments in Paleobiology and Earth History Series, 1996).

⁶³ Eutrophication occurs as a higher level of nutrients in a body of water generates a higher level of overall biological productivity. See SOLOMON ET AL., *supra* note 37, at 1220–21.

⁶⁴ See generally Thomas J. Algeo et al., *Late Devonian Oceanic Anoxic Events and Biotic*

vonian plant hypothesis would suggest that the expansion of terrestrial plants may have fatally disrupted many forms of marine life. The significance of this revelation is that the Devonian mass extinction event may be the only one of the “big five” to have been induced by life forms rather than extraterrestrial causes. The terrestrial plants of the late Devonian may have played an evolutionary role akin to that of the cyanobacteria whose prodigious oxygen production 2.3 billion years ago irrevocably poisoned the atmosphere for the obligate anaerobes that had dominated earth since the Archaean era (3.8 to 2.5 billion years ago).⁶⁵ Yet scientists have not been able to eliminate extraterrestrial explanations for the late Devonian mass extinction event. Once again, evidence of a bolide collision has muddied the waters.⁶⁶

Generalizing the impact theory beyond the Cretaceous-Tertiary extinctions has sparked fierce debate. If extraterrestrial phenomena precipitated one mass extinction event, might they have caused others? These events might even lend themselves to prediction, for asteroids, meteors, and comets, like planets, follow cyclical timetables.⁶⁷ One line of statistical analysis suggests that peaks in the extinction rate of marine invertebrates recur in 26 million-year intervals.⁶⁸ The most aggressive proponents of periodicity have argued that the 26 million-year clock depends on Nemesis, our sun’s as yet undetected companion star, whose eccentric orbit through the Oort cloud periodically hurls comets toward earth.⁶⁹ A competing school of thought dismisses the apparent periodicity of extinction events as a mere statistical anomaly.⁷⁰ One recent study suggests that

Crises: “Rooted” in the Evolution of Vascular Land Plants?, 5 GEOLOGICAL SOC’Y AM. TODAY 45, 64–66 (1995); Thomas J. Algeo & Stephen E. Scheckler, *Terrestrial-Marine Teleconnections in the Devonian: Links Between the Evolution of Land Plants, Weathering Processes, and Marine Anoxic Events*, 353 PHIL. TRANSACTIONS ROYAL SOC’Y LONDON SERIES B 113 (1998).

⁶⁵ See generally James F. Kasting & Janet L. Siefert, *Life and the Evolution of Earth’s Atmosphere*, 296 SCI. 1066 (2002). The second of four eons in geological history, the Archaean is regarded as beginning 4.3 to 3.8 billion years ago. The name *Archaean* is derived from the Greek word for “beginning.” See THE OXFORD COMPANION TO THE EARTH 33 (Paul L. Hancock & Brian J. Skinner eds., 2000).

⁶⁶ See Brooks B. Ellwood et al., *Impact Ejecta Layer from the Mid-Devonian: Possible Connection to Global Mass Extinctions*, 300 SCI. 1734 (2003).

⁶⁷ See generally GEOLOGICAL IMPLICATIONS OF IMPACTS OF LARGE ASTEROIDS AND COMETS ON THE EARTH (L. T. Silver & P. H. Schultz eds., 1982).

⁶⁸ See David M. Raup & J. John Sepkoski, Jr., *Periodicity of Extinctions in the Geologic Past*, 81 PROC. NAT’L ACAD. SCI. 801 (1984); David M. Raup & J. John Sepkoski, Jr., *Periodic Extinction of Families and Genera*, 231 SCI. 833 (1986).

⁶⁹ See Marc Davis et al., *Extinction of Species by Periodic Comet Showers*, 308 NATURE 715 (1984); DAVID M. RAUP, THE NEMESIS AFFAIR: A STORY OF THE DEATH OF DINOSAURS AND THE WAYS OF SCIENCE (1985).

⁷⁰ See Antoni Hoffman, *Patterns of Family Extinction Depend on Definition and Geological Timescale*, 315 NATURE 659 (1985); Richard A. Kerr, *Periodic Extinctions and Impacts Challenged*, 227 SCI. 1451 (1985). For entertaining accounts of the scientific fury over the impact theory and the periodicity debate, see RICHARD FORTEY, LIFE: A NATURAL HISTORY OF THE FIRST FOUR BILLION YEARS OF LIFE ON EARTH 238–60 (1997); CHARLES OFFICER & JAKE PAGE, THE GREAT DINOSAUR EXTINCTION CONTROVERSY (1996); RAUP, *supra* note 69.

fluctuations in the evolutionary record resemble each other, as fractals do, and exhibit the sort of scaling behavior observed in many biological (or even socioeconomic) systems.⁷¹ The suggestion that the power laws that govern a wide variety of natural, physical, and social systems would also control fluctuations in natural history is precisely what the periodicity hypothesis would predict.⁷²

In describing the periodicity controversy—or, for that matter, other disputes over mass extinction events—I do not intend to engage scientific debates in which I claim no expertise and possess even less. Rather, I wish merely to observe, at least from a casual, non-expert's perspective, that mass extinction events tend to have generally resulted from extraterrestrial causes, or at least abiotic terrestrial phenomena such as mass volcanism⁷³ or sea-level change. Aside from the cyanobacterial conversion of the anoxic pre-Cambrian atmosphere and the global cooling that may have been triggered by terrestrial plants during the late Devonian, living things seldom contribute to the wholesale, wanton elimination of other life forms.

From the perspective of geological time, human civilization qualifies as a mass extinction event in its own right. The “Holocene mass extinction” may approximate the events that ushered out the trilobites, ammonites, and dinosaurs.⁷⁴ In evolutionary terms, human activity has easily outclassed an ice age, or even twenty.⁷⁵ We may be witnessing the first geologi-

⁷¹ See Ricard V. Solé et al., *Self-Similarity of Extinction Statistics in the Fossil Record*, 388 NATURE 764 (1997).

⁷² See generally PER BAK, *HOW NATURE WORKS: THE SCIENCE OF SELF-ORGANIZED CRITICALITY* (1996); MANFRED SCHROEDER, *FRACTALS, CHAOS, POWER LAWS: MINUTES FROM AN INFINITE PARADISE* 103–19 (1991). For applications of power laws by a legal scholar, see Daniel A. Farber, *Probabilities Behaving Badly: Complexity Theory and Environmental Uncertainty*, 37 U.C. DAVIS L. REV. 145, 154 (2003) (noting that “Supreme Court opinions . . . appear to follow a power law in terms of their frequency of citation”); Daniel A. Farber, *Earthquakes and Tremors in Statutory Interpretation: An Empirical Study of the Dynamics of Interpretation*, 89 MINN. L. REV. 848 (2005). For explanations of the inverse relationship between population density and body size, a biologically critical phenomenon, see, for example, ROBERT HENRY PETERS, *THE ECOLOGICAL IMPLICATIONS OF BODY SIZE* (1983); Chris Carbone & John L. Gittleman, *A Common Rule for the Scaling of Carnivore Density*, 295 SCI. 2273 (2002); Pablo A. Marquet, *Of Predators, Prey, and Power Laws*, 295 SCI. 2229 (2002); David R. Morse et al., *Fractal Dimension of Vegetation and the Distribution of Arthropod Body Lengths*, 314 NATURE 731 (1985).

⁷³ Cf. Paul B. Wignall, *Large Igneous Provinces and Mass Extinctions*, 53 EARTH-SCI. REVIEWS 1 (2001) (disputing the presence of a general connection between volcanic activity and mass extinctions).

⁷⁴ See generally NILES ELDREDGE, *LIFE IN THE BALANCE: HUMANITY AND THE BIODIVERSITY CRISIS* (1998).

⁷⁵ Compare Jared M. Diamond, *Quaternary Megafaunal Extinctions: Variations on a Theme by Paganini*, 16 J. ARCHAEOLOGICAL SCI. 167 (1989) (observing that many large mammals became extinct upon the arrival of humans in the Americas, 11,000 years before the present) with John Alroy, *A Multispecies Overkill Simulation of the End-Pleistocene Megafaunal Mass Extinction*, 292 SCI. 1893 (2001) (modeling the mass extinction event at the end of Pleistocene epoch as one of overkill by humans). See generally QUATERNARY EXTINCTIONS: A PREHISTORIC REVOLUTION (Paul S. Martin & Richard G. Klein eds., 1984). For perspectives on the fierce debate over the extent to which human colonization

cal episode in nearly 400 million years—or perhaps even 2.2 billion years, if we prefer counting back to the boundary between the Archaean and Proterozoic eras of Precambrian time—in which the rampant success of one form of life has doomed many unrelated species. In the language of paleontology as in everyday speech, contemporary mass extinctions mark the end of an epoch. At an absolute minimum, we are “in the midst of one of the largest experiments in the history of the Earth.”⁷⁶

Just how much biodiversity hangs in the balance? Even the most conservative assessments must concede that human activity has an enormous (if not easily quantified) evolutionary impact. Some sources estimate that earth’s biodiversity encompasses five to 30 million species of living organisms.⁷⁷ Biologists, however, “do not know to the nearest order of magnitude how many species exist on earth.”⁷⁸ Because it is premature to “trust any estimate of the global total of species,”⁷⁹ all policies bearing on biodiversity are necessarily framed in ignorance.⁸⁰ Whatever merit lies in the notion that ecosystems supply valuable services to human society,⁸¹

affected the ecology of North America, see generally TIM FLANNERY, *THE ETERNAL FRONTIER: AN ECO-HISTORY OF NORTH AMERICA AND ITS PEOPLES 194–95* (2001); ALICE BECK KEHOE, *AMERICA BEFORE THE EUROPEAN INVASIONS* (2002); SHEPARD KETCH III, *THE ECOLOGICAL INDIAN: MYTH AND HISTORY* (1999); TED STEINBERG, *DOWN TO EARTH: NATURE’S ROLE IN AMERICAN HISTORY* 11 (2002). On mammoths, enshrined in the romantic imagination as the signature mammals of the Pleistocene, see RICHARD STONE, *MAMMOTH: THE RESURRECTION OF AN ICE AGE GIANT* (2001); R. Dale Guthrie, *Radiocarbon Evidence of Mid-Holocene Mammoths Stranded on an Alaskan Bering Sea Island*, 429 *NATURE* 746 (2004).

⁷⁶ F. Stuart Chapin III et al., *Consequences of Changing Biodiversity*, 405 *NATURE* 234, 241 (2000).

⁷⁷ See E. O. Wilson, *The Current State of Biological Diversity*, in *BIODIVERSITY*, *supra* note 37, at 3, 5; Mark A. Urbanski, Note, *Chemical Prospecting, Biodiversity Conservation, and the Importance of International Protection of Intellectual Property Rights in Biological Materials*, 2 *BUFF. J. INT’L L.* 131, 133 (1995).

⁷⁸ WILSON, *supra* note 22, at 273.

⁷⁹ May, *supra* note 39, at 1448.

⁸⁰ Cf. DAVID TAKACS, *THE IDEA OF BIODIVERSITY: PHILOSOPHIES OF PARADISE* 92 (1996) (urging ecologists to lead as “masters of ignorance” by advising policymakers to eschew irreversible actions until they fully understand the consequences). For provocative criticism of the precautionary principle implicit in this approach, see Frank B. Cross, *Paradoxical Perils of the Precautionary Principle*, 53 *WASH. & LEE L. REV.* 851 (1996); Frank B. Cross, *The Subtle Vices Behind Environmental Values*, 8 *DUKE ENVTL. L. & POL’Y F.* 151 (1997). For discussion of the precautionary principle generally, see PERSPECTIVES ON THE PRECAUTIONARY PRINCIPLE (Ronnie Harding & Elizabeth Fisher eds., 1999); PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT: IMPLEMENTING THE PRECAUTIONARY PRINCIPLE (Carolyn Raffensperger & Joel A. Tickner eds., 1999); Gail Charnley & E. Donald Elliot, *Risk Versus Protection: Environmental Law and Public Health Protection*, 32 *Envtl. L. Rep. (Envtl. L. Inst.)* 10,363 (2002); Neil A. Manson, *Formulating the Precautionary Principle*, 24 *ENVTL. ETHICS* 263 (2002); Jonathan B. Wiener, *Whose Precaution After All? A Comment on the Comparison and Evolution of Risk Regulatory Systems*, 13 *DUKE J. COMP. & INT’L L.* 207 (2003).

⁸¹ See generally GRETCHEN C. DAILY & KATHERINE ELLISON, *THE NEW ECONOMY OF NATURE: THE QUEST TO MAKE CONSERVATION PROFITABLE* (2002); PANEL ON BIODIVERSITY AND ECOSYSTEMS, PRESIDENT’S COMMITTEE OF ADVISORS ON SCIENCE AND TECHNOLOGY, *TEAMING WITH LIFE: INVESTING IN SCIENCE TO UNDERSTAND AND USE AMERICA’S LIVING CAPITAL* (1998); *NATURE’S SERVICES: SOCIETAL DEPENDENCE ON NATURAL*

we do know with a demoralizing degree of certainty that biodiversity losses exact a grotesque human price. The disturbances with the “greatest ecological impact frequently incur high societal costs.”⁸²

The mounting evidence of humanity’s profoundly negative impact on biodiversity is becoming harder to contradict. Consider, for instance, a 2004 study on the regional extinctions of birds, butterflies, and vascular plants in Britain.⁸³ Earlier studies of global biodiversity have exhaustively documented extinctions among plants, vertebrates, and certain mollusks.⁸⁴ These studies shed relatively little light on the global scope of biodiversity loss insofar as they did not cover organisms representing a sufficiently large sample of earth’s described species. Insect species, however, represent 54% of all fauna.⁸⁵ Decreases of 28% among native plant species, 54% of native bird species, and 71% of butterfly species in Britain therefore raise more serious concerns.⁸⁶ “The greater loss among British butterfly species may foreshadow similar declines in birds and plants, because insect populations typically respond more rapidly to adverse environmental change than longer-lived organisms or those with dormant propagules.”⁸⁷ Further confirmation of declines among insect populations akin to those already documented in taxa whose species abundance is better

ECOSYSTEMS (Gretchen C. Daily ed., 1997); James Salzman, *Valuing Ecosystem Services*, 24 *ECOLOGY* L.Q. 887 (1997) (book review); Graciela Chichilnisky & Geoffrey Heal, *Economic Returns from the Biosphere*, 391 *NATURE* 629 (1998); Janet S. Herman et al., *Groundwater Ecosystems and the Service of Water Purification*, 20 *STAN. ENVTL. L.J.* 479 (2001); John B. Loomis & Douglas S. White, *Economic Benefits of Rare and Endangered Species: Summary and Meta-Analysis*, 18 *ECOLOGICAL ECON.* 197 (1996); H. A. Mooney et al., *Biodiversity and Ecosystem Functioning: Basic Principles*, in *GLOBAL BIODIVERSITY ASSESSMENT* 275 (Vernon Hilton Heywood & R. T. Watson eds., 1995); James Salzman & J. B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 *STAN. L. REV.* 607 (2000); James Salzman et al., *Protecting Ecosystem Services: Science, Economics, and Law*, 20 *STAN. ENVTL. L.J.* 309 (2001); Barton H. Thompson, Jr., *Markets for Nature*, 25 *WM. & MARY ENVTL. L. & POL’Y REV.* 261 (2000); Barton H. Thompson, Jr., *People or Prairie Chickens: The Uncertain Search for Optimal Biodiversity*, 51 *STAN. L. REV.* 1127 (1999).

⁸² Chapin et al., *supra* note 76, at 239.

⁸³ See J.A. Thomas et al., *Comparative Losses of British Butterflies, Birds, and Plants and the Global Extinction Crisis*, 303 *SCI.* 1879 (2004).

⁸⁴ See, e.g., May et al., *supra* note 38; Robert M. May & Kerry Tregonning, *Global Conservation and U.K. Government Policy*, in *CONSERVATION IN A CHANGING WORLD* 287 (Georgina M. Mace et al. eds., 1998); Stuart L. Pimm et al., *The Future of Biodiversity*, 269 *SCI.* 347 (1995).

⁸⁵ See Thomas et al., *supra* note 83, at 1880.

⁸⁶ See *id.* at 1879–80.

⁸⁷ *Id.* at 1880; see also *THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE* 1452 (3d ed. 1992) (defining “propagule” as “[a]ny of various usually vegetative portions of a plant, such as a bud or other offshoot, that aid in dispersal of the species and from which a new individual may develop”). See generally Andreas Erhardt & Jeremy A. Thomas, *Lepidoptera as Indicators of Change in the Semi-Natural Grasslands of Lowland and Upland Europe*, in *THE CONSERVATION OF INSECTS AND THEIR HABITATS* 213 (N. Mark Collins & J. A. Thomas eds., 1991); Amy E. M. Waltz & W. Wallace Covington, *Ecological Restoration Treatments Increase Butterfly Richness and Abundance: Mechanisms of Response*, 12 *RESTORATION ECOLOGY* 85 (2004).

understood⁸⁸ will bring us that much closer to declaring “that the biological world is approaching the sixth major extinction event in its history.”⁸⁹

II. ENFORCING ENVIRONMENTAL VALUES THROUGH “SUPER-STATUTES”

What, if anything, can the law do to reverse human civilization’s singular threat to the global environment? Despite its staggering magnitude, biodiversity loss is merely one manifestation of the many environmental challenges confronting the law. The most pressing environmental problems involve the depletion and destruction of the global commons. Addressing climate change, ozone depletion, and biodiversity loss should represent the top priorities in environmental law, at home and abroad.⁹⁰ No single jurisdiction, not even one as wealthy, powerful, and influential as the United States, can hope to address these challenges alone. These “diffuse, cross-jurisdictional” environmental crises defy “haphazard local encouragement” and require cooperative solutions.⁹¹ “[E]nvironmental interconnection has become too real to ignore”; the “existence of transboundary communities inevitably creates a drive away from localism in all spheres.”⁹²

Though accomplished on a global scale, sound environmental policy begins at home. A commitment to environmental integrity as fundamental domestic law certainly helps. Numerous countries enshrine environmental principles within their constitutions. Argentina, for instance, grants “[a]ll inhabitants . . . the right to a healthy and balanced environment fit for human development in order that productive activities shall meet present needs without endangering those of future generations.”⁹³ The Argentine constitution also commits that country’s federal government to “provide for the protection of this right, the rational use of natural resources, the preservation of the [nation’s] natural and cultural heritage and of [its] biological diversity.”⁹⁴ India pledges to “endeavour to protect and improve the environment and to safeguard the forests and wild life of the country.”⁹⁵ The Polish constitution requires “[p]ublic authorities [to] pursue policies en-

⁸⁸ See Michael L. McKinney, *High Rates of Extinction and Threat in Poorly Studied Taxa*, 13 CONSERVATION BIOLOGY 1273 (1999).

⁸⁹ Thomas et al., *supra* note 83, at 1881. Further confirmation of the overall threat to biodiversity comes through the first global assessment of amphibians, which are “more threatened and are declining more rapidly than either birds or mammals.” Simon N. Stuart et al., *Status and Trends of Amphibian Declines and Extinctions Worldwide*, 306 SCI. 1783, 1783 (2004).

⁹⁰ See ENVIRONMENTAL PROTECTION AGENCY, SCIENCE ADVISORY BOARD, REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION 13 (1990).

⁹¹ Stephen M. Nickelsburg, Note, *Mere Volunteers? The Promise and Limits of Community-Based Environmental Protection*, 84 VA. L. REV. 1371, 1409 (1998).

⁹² Daniel A. Farber, *Stretching the Margins: The Geographic Nexus in Environmental Law*, 48 STAN. L. REV. 1247, 1271 (1996).

⁹³ ARG. CONST., ch. II, § 41.

⁹⁴ *Id.*

⁹⁵ INDIA CONST., pt. IV, art. 48A.

sure the ecological security of current and future generations” and granting citizens “the right to be informed of the quality of the environment and its protection.”⁹⁶ Through the Rio Declaration on Environment and Development, the international community has proclaimed that “[t]he right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.”⁹⁷

Despite the Supreme Court’s characterization of the United States Constitution as a covenant running across generations,⁹⁸ the fundamental law of the United States makes no explicit pledge to protect the environment. American law nevertheless enjoys other means to secure special legal status for environmental protection.⁹⁹ The National Environmental Policy Act of 1970 (“NEPA”)¹⁰⁰ and the Endangered Species Act of 1973 (“ESA”)¹⁰¹ head the list of environmental “super-statutes” whose “institutional [and] normative” impact reaches issues ordinarily addressed through Constitutional law.¹⁰² These statutes heralded a revolutionary cycle of federal environmental statutes.¹⁰³ For all their faults, NEPA and the ESA outperform constitutional law in protecting the interests of future generations.¹⁰⁴ NEPA expressly declares the federal government’s “continuing policy . . . [to] fulfill the social, economic, and other requirements of present and future generations”¹⁰⁵ and describes “the responsibilities of each generation as trustee of the environment for succeeding generations.”¹⁰⁶ This statutory declaration thus provides the American expression of a principle that many other nations proclaim (and protect) through constitutional law: no system of environmental ethics can sustain significant normative appeal unless its first precept demands the preservation of the interests of future generations.¹⁰⁷

⁹⁶ POLAND CONST., ch. II, art. 74.

⁹⁷ U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1 (June 14, 1992) (principle 3) [hereinafter *Rio Declaration*].

⁹⁸ *Planned Parenthood of S.E. Pa. v. Casey*, 505 U.S. 833, 901 (1992).

⁹⁹ See generally Doremus, *supra* note 1.

¹⁰⁰ 42 U.S.C. §§ 4321–4370f (2000).

¹⁰¹ 16 U.S.C. §§ 1531–1544 (2000).

¹⁰² William N. Eskridge, Jr. & John Ferejohn, *Super-Statutes*, 50 DUKE L.J. 1215, 1216 (2001).

¹⁰³ See generally THE COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY: 20TH ANNUAL REPORT (1990) (commemorating NEPA’s twentieth anniversary); Jerry L. Anderson, *The Environmental Revolution at Twenty-Five*, 26 RUTGERS L.J. 395 (1995).

¹⁰⁴ See Daniel A. Farber, *Is the Supreme Court Irrelevant? Reflections on the Judicial Role in Environmental Law*, 81 MINN. L. REV. 547, 547–48 (1997).

¹⁰⁵ 42 U.S.C. § 4331(a) (2000).

¹⁰⁶ *Id.* § 4331(b)(1).

¹⁰⁷ See Edith Brown Weiss, *Our Rights and Obligations to Future Generations for the Environment*, 84 AM. J. INT’L L. 198, 201–02 (1990). See generally DONALD EDWARD DAVIS, *ECOPHILOSOPHY: A FIELD GUIDE TO THE LITERATURE* (1989); RODERICK FRAZIER NASH, *THE RIGHTS OF NATURE: A HISTORY OF ENVIRONMENTAL ETHICS* (1989); EDITH BROWN WEISS, *IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON*

Although NEPA is best known as a source of procedural obligations, one of its critical provisions establishes an interpretive principle that is tantamount to a “green” canon. “Congress authorizes and directs that, to the fullest extent possible . . . the policies, regulations and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in” NEPA.¹⁰⁸ This language unambiguously requires the laws of the United States to be interpreted and implemented so that they address all significant environmental risks, for the benefit of future generations as well as today’s citizenry.¹⁰⁹ If this provision of NEPA has any meaning, legal ambiguities should be resolved in favor of the environment, even when—and perhaps *especially* when—competing economic interests might support a different answer. This sort of substantive canon resembles the very familiar canon urging the interpretation of statutes so as not to raise doubts over the constitutionality of acts of Congress.¹¹⁰ That interpretive canon in practice is a species of constitutional lawmaking,¹¹¹ and NEPA’s “green” canon likewise has the potential to serve as a significant source of substantive environmental principles.

PATRIMONY, AND INTERGENERATIONAL EQUITY (1989); Annette Baier, *For the Sake of Future Generations*, in *EARTHBOUND: NEW INTRODUCTORY ESSAYS IN ENVIRONMENTAL ETHICS* 214 (Tom Regan ed., 1984); Dan M. Berkovitz, *Pariahs and Prophets: Nuclear Energy, Global Warming, and Intergenerational Justice*, 17 *COLUM. J. ENVTL. L.* 245 (1992); Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 *VAND. L. REV.* 267, 289 (1993) (discussing intergenerational equity in cost-benefit analysis); Lawrence B. Solum, *To Our Children’s Children’s Children: The Problems of Intergenerational Ethics*, 35 *LOY. L.A. L. REV.* 163 (2001); Edith Brown Weiss, *The Planetary Trust: Conservation and Intergenerational Equity*, 11 *ECOLOGY L.Q.* 495 (1984).

¹⁰⁸ 42 U.S.C. § 4332 (2000).

¹⁰⁹ See DANIEL A. FARBER, *ECO-PRAGMATISM: MAKING SENSIBLE ENVIRONMENTAL DECISIONS IN AN UNCERTAIN WORLD* 125–27 (1999); Nicholas Yost, *NEPA’s Promise—Partially Fulfilled*, 20 *ENVTL. L.* 533, 536 (1990).

¹¹⁰ See, e.g., *Edward J. DeBartolo Corp. v. Fla. Gulf Coast Bldg. & Constr. Trades Council*, 485 U.S. 568, 575 (1988); *NLRB v. Catholic Bishop*, 440 U.S. 490, 499–01 (1979); *Murray v. The Charming Betsy*, 6 U.S. (2 Cranch) 64, 118 (1804); cf., e.g., *Almendarez-Torres v. United States*, 523 U.S. 224, 237–38 (1998) (asserting that courts ought to avoid interpreting the Constitution when some other basis for decision fairly presents itself); *Spector Motor Serv., Inc. v. McLaughlin*, 323 U.S. 101, 105 (1944) (same); *Ashwander v. TVA*, 297 U.S. 288, 347 (1936) (Brandeis, J., concurring) (same).

¹¹¹ See William N. Eskridge, Jr. & Philip P. Frickey, *Quasi-Constitutional Law: Clear Statement Rules as Constitutional Lawmaking*, 45 *VAND. L. REV.* 593, 599 (1992); William N. Eskridge, Jr. & Philip P. Frickey, *The Supreme Court, 1993 Term—Foreword: Law as Equilibrium*, 108 *HARV. L. REV.* 26, 81–87 (1994). For cases suggesting that the current Supreme Court is aggressively transforming the constitutional avoidance canon into “a roving commission to construe all meaningful life out of regulatory statutes that offend a majority of Justices,” Jim Chen, *Filburn’s Legacy*, 52 *EMORY L.J.* 1719, 1754 (2003), see *Solid Waste Agency of N. Cook County v. U.S. Army Corps of Eng’rs*, 531 U.S. 159, 174 (2001) (invalidating the Corps’s “Migratory Bird Rule” in order “to avoid the significant constitutional and federalism questions raised” by this interpretation of the term “navigable waters” within the Clean Water Act); *Jones v. United States*, 529 U.S. 848, 859 (2000) (holding that the federal arson statute “covers only property currently used in commerce or in an activity affecting commerce,” in order to avoid casting doubt on the statute’s constitutionality after *United States v. Lopez*, 514 U.S. 549 (1995)).

Of course, NEPA does frame the process by which the federal government considers the environmental impact of its major decisions. NEPA directs the federal government to consider not only the “relationship between local short-term uses of [the] environment and the maintenance and enhancement of long-term productivity,” but also any “irreversible and irretrievable commitment of resources.”¹¹² Environmental impact statements prepared under NEPA must consider “ecological” effects—namely, “effects on natural resources and on the components, structures, and functioning of . . . ecosystems” affected by major federal action.¹¹³ Perhaps NEPA’s greatest accomplishment is its establishment of the principle that the federal government take no major action without first assessing the environmental impact of its decisions. Today’s international efforts to assess biodiversity, climate change, and other global environmental phenomena—perhaps the most vital scientific tools in humanity’s struggle to forestall biological disaster¹¹⁴—have a predecessor in one of the United States’ foundational environmental statutes.

The Supreme Court, however, has barred the use of NEPA to review agency decisions on their merits. “NEPA itself does not mandate particular results,” the Court has held, “but simply prescribes the necessary process.”¹¹⁵ Indeed, a crippled NEPA has come to exemplify “soft look” review in administrative law.¹¹⁶ The Court’s admonitions that federal agencies should take a nominally “hard look” at the environmental consequences of their decisions¹¹⁷ in practice “mandat[e]” little “more than the physical act of passing certain folders and papers [among] reviewing officials” and thereby threaten to “make a mockery of the Act.”¹¹⁸

¹¹² 42 U.S.C. § 4332(c)(iv), (v) (2000); *see also* 40 C.F.R. § 1502.16 (2004) (requiring consideration of “any irreversible or irretrievable commitments of resources” in an environmental impact statement’s discussion of environmental consequences).

¹¹³ 40 C.F.R. § 1508.8 (2004).

¹¹⁴ *See generally* Walter V. Reid, *Strategies for Conserving Biodiversity*, 39 ENV’T 16 (1997) (assessing the impact of works such as GLOBAL BIODIVERSITY ASSESSMENT, *supra* note 81, and the work of the Intergovernmental Panel on Climate Change).

¹¹⁵ *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); *accord* *Morongo Band of Mission Indians v. Fed. Aviation Adm’n*, 161 F.3d 569, 575 (9th Cir. 1998) (“NEPA exists to ensure a process, not a result.”); *see also* *Strycker’s Bay Neighborhood Council, Inc. v. Karlen*, 444 U.S. 223, 227–28 (1980) (*per curiam*); *Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc.*, 435 U.S. 519, 558 (1978).

¹¹⁶ *See, e.g.*, *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 103 (1983). For a thoughtful look at NEPA’s shortcomings and a proposal for improving the statute’s performance, *see* Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government’s Environmental Performance*, 102 COLUM. L. REV. 703 (2002).

¹¹⁷ *See, e.g.*, *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 376–77 (1989); *Kleppe v. Sierra Club*, 427 U.S. 390, 410 n.21 (1976).

¹¹⁸ *Calvert Cliffs’ Coordinating Comm., Inc. v. U.S. Atomic Energy Comm’n*, 449 F.2d 1109, 1117 (D.C. Cir. 1971). On the relative merits of piercing “hard look” review of administrative discretion relative to those of the more deferential “soft look” alternative, *see generally* Richard J. Pierce, Jr., *Judicial Review of Agency Actions in a Period of Diminishing Agency Resources*, 49 ADMIN. L. REV. 61 (1997). *Compare* *Salameda v. INS*, 70 F.3d 447, 452 (7th Cir. 1995) (Posner, J.) (refusing to treat “resource constraints” and “under-

Among the irreversible events addressed by NEPA, none is bleaker than extinction.¹¹⁹ At least with respect to combatting biodiversity loss, American law boasts an alternative and fairly robust statutory tool, one that combines NEPA's aspirations and procedural framework with a dramatically more robust set of substantive mandates.¹²⁰ Whatever else might be said for the political foibles of American environmental law,¹²¹ the Endangered Species Act of 1973 ("ESA") may represent "the most comprehensive legislation for the preservation of endangered species ever enacted by any nation."¹²² American environmental law affords "endangered species . . . the highest of priorities."¹²³

To be sure, the ESA is quite often honored solely in the breach. The perception that this statute inflexibly restricts land use¹²⁴ has fueled "the 'scorched earth' technique" of preemptively clearing potential wildlife habitat.¹²⁵ The rates at which landowners "shoot, shovel, and shut up"¹²⁶ can

staffing" as "defense[s] to a violation of principles of administrative law") *with id.* at 458 (Easterbrook, J., dissenting) (urging judicial accommodation of the "inevitability of error in a large population of [administrative] decisions," lest excessively harsh judicial review force agencies to "lavish scarce time and energy on non-issues in simple cases"). For an extended academic debate over "hard" and "soft" look in the context of "deossifying" administrative law, see Thomas O. McGarity, *Some Thoughts on "Deossifying" the Rule-making Process*, 41 DUKE L.J. 1385, 1453 (1992); Mark Seidenfeld, *Demystifying Deossification: Rethinking Recent Proposals to Modify Judicial Review of Notice and Comment Rulemaking*, 75 TEX. L. REV. 483 (1997); Thomas O. McGarity, *The Courts and the Ossification of Rulemaking: A Response to Professor Seidenfeld*, 75 TEX. L. REV. 525 (1997); Mark Seidenfeld, *Hard Look Review in a World of Techno-Bureaucratic Decision-making: A Reply to Professor McGarity*, 75 TEX. L. REV. 559 (1997).

¹¹⁹ Fred P. Bosselman, *Extinction and the Law: Protection of Religiously-Motivated Behavior*, 68 CHI.-KENT L. REV. 15, 15 (1992).

¹²⁰ Cf. *Thomas v. Peterson*, 753 F.2d 754, 764 (9th Cir. 1985) ("The procedural requirements of the [Endangered Species Act] are analogous to those of NEPA . . .").

¹²¹ See generally, e.g., GUS SPETH, *RED SKY AT MORNING: AMERICA AND THE CRISIS OF THE GLOBAL ENVIRONMENT* (2004); Richard J. Lazarus, *A Different Kind of "Republican" Moment in Environmental Law*, 87 MINN. L. REV. 999 (2003), reprinted in *THE JURISDYNAMICS OF ENVIRONMENTAL PROTECTION: CHANGE AND THE PRAGMATIC VOICE IN ENVIRONMENTAL LAW* 369 (Jim Chen ed., 2003) [hereinafter *JURISDYNAMICS*].

¹²² *TVA v. Hill*, 437 U.S. 153, 180 (1978).

¹²³ *Id.* at 174; accord, e.g., *Forest Conservation Council v. Rosboro Lumber Co.*, 50 F.3d 781, 787 (9th Cir. 1995); *Pyramid Lake Paiute Tribe of Indians v. U.S. Dep't of the Navy*, 898 F.2d 1410, 1417 (9th Cir. 1990).

¹²⁴ See, e.g., Dean Lueck, *The Law and Politics of Federal Wildlife Preservation*, in *POLITICAL ENVIRONMENTALISM: GOING BEHIND THE GREEN CURTAIN* 61, 72–80 (Terry L. Anderson ed., 2000). On the listing of the northern spotted owl as an endangered species and the designation of its critical habitat, see *Seattle Audubon Soc'y v. Moseley*, 80 F.3d 1401, 1403–04 (9th Cir. 1996); cf. Christopher Cole, *Species Conservation in the United States: The Ultimate Failure of the Endangered Species Act and Other Land Use Laws*, 72 B.U. L. REV. 343, 350–54 (1992) (describing the Act as unduly harsh and ineffective).

¹²⁵ Michael J. Bean, *Overcoming Unintended Consequences of Endangered Species Regulation*, 38 IDAHO L. REV. 409, 415 (2002) (quoting NAT'L ASS'N OF HOME BUILDERS, DEVELOPER'S GUIDE TO ENDANGERED SPECIES REGULATION 109 (1996)); see also George Cameron Coggins & Anne Fleishel Harris, *The Greening of American Law?: The Recent Evolution of Federal Law for Preserving Floral Diversity*, 27 NAT. RES. J. 247, 297 (1987).

¹²⁶ Shi-Ling Hsu, *A Game-Theoretic Approach to Regulatory Negotiation and a Framework for Empirical Analysis*, 26 HARV. ENVTL. L. REV. 33, 58 (2002).

be tracked, for instance, by measuring whether harvesting rates in southeastern pine forests vary according to the presence of the federally protected red-cockaded woodpecker.¹²⁷ Moreover, Congress routinely bends to political pressure to cripple the listing of endangered and threatened species under section 4 of the ESA.¹²⁸ Though extinctions proceed apace, Congress has been known to impose a moratorium on the expansion of the endangered species list,¹²⁹ only to suspend such moratoria when political winds shift.¹³⁰

Translating the ESA into effective biodiversity policy poses a daunting challenge. Whether one characterizes the causes of biodiversity loss as an “Evil Quartet” of habitat destruction, overkill, introduced species, and secondary extinctions,¹³¹ or whether one prefers the acronym HIPPO for Habitat destruction, Invasive species, Pollution, Population, and Overharvesting,¹³² it is clear which horse of the ecological apocalypse stampedes hardest and fastest: habitat destruction. “[T]he principal cause of biodiversity loss is the fragmentation, degradation, and destruction of ecosystems and habitats through conversion of land to economically productive uses, especially agriculture, forestry, mineral and fossil fuel extraction, and urban development.”¹³³

The ESA does address habitat destruction, albeit only indirectly and only after immense legal controversy. Perversely enough, however, the ESA

¹²⁷ See Dean Lueck & Jeffrey A. Michael, *Preemptive Habitat Destruction Under the Endangered Species Act*, 46 J.L. & ECON. 27 (2003) (documenting higher harvest rates near woodpecker habitat and speculating that timber owners are harvesting before woodpeckers—and the land-use restrictions that follow them—move in).

¹²⁸ See 16 U.S.C. § 1533(d) (2000).

¹²⁹ See Emergency Supplemental Appropriations & Rescissions for the Department of Defense to Preserve & Enhance Military Readiness Act of 1995, Pub. L. No. 104-6, 109 Stat. 73, 86 (1995).

¹³⁰ See Suspension of the Proviso Limiting Implementation of Subsections (a), (b), (c), (e), (g), or (i) of the Endangered Species Act of 1973 (16 U.S.C. § 1533) Contained in the Omnibus Consolidated Rescissions and Appropriations Act of 1996 (H.R. 3019), 61 Fed. Reg. 24,667 (May 16, 1996). See generally Jason M. Patlis, *Riders on the Storm, Or Navigating the Crosswinds of Appropriations and Administration of the Endangered Species Act: A Play in Five Acts*, 16 TUL. ENVTL. L.J. 257 (2003).

¹³¹ See Jared Diamond, “Normal” Extinctions of Isolated Populations, in EXTINCTIONS 191 (M. H. Nitecki ed., 1984); Jared Diamond, *Overview of Recent Extinctions*, in CONSERVATION FOR THE TWENTY-FIRST CENTURY 37, 39–41 (David Western & Mary C. Pearl eds., 1989).

¹³² See EDWARD O. WILSON, *THE FUTURE OF LIFE* 50–51 (2002).

¹³³ Bradley C. Karkkainen, *Biodiversity and Land*, 83 CORNELL L. REV. 1, 7 (1997); see also, e.g., Myrl L. Duncan, *Property as a Public Conversation, Not a Lockean Soliloquy: A Role for Intellectual and Legal History in Takings Analysis*, 26 ENVTL. L. 1095, 1127–29 (1996); Paul R. Ehrlich, *The Loss of Diversity: Causes and Consequences*, in BIODIVERSITY, *supra* note 37, at 21, 21; cf. Larry E. Morse et al., *Native Vascular Plants, in OUR LIVING RESOURCES: REPORT TO THE NATION ON THE DISTRIBUTION, ABUNDANCE, AND HEALTH OF U.S. PLANTS, ANIMALS, AND ECOSYSTEMS* 205, 208 (1995) (describing “[h]abitat alteration and incompatible land use” as greater threats than overcollecting, global climate change, and sea-level rise). See generally Bruce A. Wilcox & Dennis D. Murphy, *Conservation Strategy: The Effects of Fragmentation on Extinction*, 125 AM. NATURALIST 879 (1985).

aims its harshest sanctions at explicit acts of overkill, which are spectacular and salient enough to attract legal and political attention but have relatively little impact on biodiversity conservation. Section 9 of the ESA makes it “unlawful for any person subject to the jurisdiction of the United States to . . . take any [endangered] species within the United States or the territorial sea of the United States.”¹³⁴ The ESA defines the term “take” as meaning “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.”¹³⁵ Although the statute itself provides no further definition of these terms, the Department of the Interior has issued a regulation defining the word “harm,” which falls within the statutory definition of “take,” to “include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.”¹³⁶ In *TVA v. Hill*,¹³⁷ one of the earliest and most prominent cases interpreting the ESA, the Supreme Court acknowledged how a proposed dam on the Tellico River would threaten every aspect of the endangered snail darter’s existence by disrupting the aeration of the river, eliminating the fish’s breeding opportunities, and exterminating snails, the darter’s primary diet.¹³⁸

In the landmark 1995 decision of *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*,¹³⁹ the Supreme Court upheld the Interior Department’s interpretation of the Act. In light of “Congress’ clear expression of the ESA’s broad purpose to protect endangered and threatened wildlife,” the Court upheld the Interior Department’s “definition of ‘harm’ [as] reasonable.”¹⁴⁰ If only incidentally, *Sweet Home* also left intact the Interior Department’s application of its habitat destruction rule to threatened species.¹⁴¹ Thanks to *Sweet Home*, the ESA gives the United States an effective legal weapon against the primary threat to global biodiversity.

Neither NEPA nor the ESA has provided consistent, effective legal protection against a second source of biodiversity loss: alien invasive species. Human-mediated introduction of exotic species is a very direct, very visible, and very damaging result of the greater interconnectedness facilitated by globalization.¹⁴² Against the damaging tide of alien invasives, exist-

¹³⁴ 16 U.S.C. § 1538 (2000).

¹³⁵ *Id.* § 1532(19) (2000).

¹³⁶ 50 C.F.R. § 17.3 (2004).

¹³⁷ 437 U.S. 153 (1978).

¹³⁸ *See id.* at 162, 166 n.16. *See generally* Oliver Houck, *Unfinished Stories*, 73 U. COLO. L. REV. 867, 921–22 (2002) (recounting the story of *Hill* and the snail darter).

¹³⁹ 515 U.S. 687 (1995).

¹⁴⁰ *Id.* at 700.

¹⁴¹ *See id.* at 692 n.5 (observing how the parties challenging the habitat destruction rule dropped their attack on 50 C.F.R. § 17.31(a), which applied the rule to threatened as well as endangered species).

¹⁴² *See, e.g.*, Theodore C. Foyn et al., *Improving Recovery Planning for Threatened and Endangered Species*, 48 *BioSci.* 177, 180–81 (1998); David S. Wilcove et al., *Quantifying*

ing law provides almost no relief. Relatively modest interpretive extensions of these statutes, however, could enable the law to respond—albeit modestly—to alien invasive species. No conceptual barrier prevents the application of the Interior Department’s definition of “harm” under the ESA—namely, performing acts that “actually kill[] or injure[]” protected wildlife¹⁴³—to actions introducing alien species that kill, outcompete, sicken, or otherwise displace threatened or endangered species. As for NEPA, one appeals court has used that statute to reprove a federal agency for failing to analyze how dam construction could introduce zebra mussels to previously uninfested waters.¹⁴⁴

Generally speaking, though, NEPA is powerless to curb invasive species. A case involving a dispute over proposed airport expansion typifies that statute’s broader record of failure. In 2000, the Ninth Circuit rejected arguments that an expanded airport could dramatically increase the rate at which commercial flights (especially from Asia) would introduce alien species into Maui.¹⁴⁵ In its refusal to find a NEPA violation, the Ninth Circuit took refuge in the vagaries of airport demand projections,¹⁴⁶ the multiplicity of invasion vectors,¹⁴⁷ and the impossibility of determining *ex ante* which species would become established and, among those, which would become economic pests.¹⁴⁸

The Maui decision effectively ignored an enormous (and growing) biological literature on the devastation wreaked by alien invasive species.¹⁴⁹ Endemic species in the lushest ecosystems—including not only the Hawaiian Islands but also the Everglades, the Great Lakes, and Guam—are vulnerable to competition, parasitism, or predation by introduced exotics.¹⁵⁰ Although “most invasions have a weak impact,” some invasive species are “capable of precipitating monumental changes to an ecosystem.”¹⁵¹

Threats to Imperiled Species in the United States, 48 *BioSci.* 607, 608–09 (1998).

¹⁴³ 50 C.F.R. § 17.3 (2004).

¹⁴⁴ See *Hughes River Watershed Conservancy v. Glickman*, 81 F.3d 437, 445 (4th Cir. 1996).

¹⁴⁵ See *Nat’l Parks & Conservation Ass’n v. U.S. Dep’t of Transp.*, 222 F.3d 677 (9th Cir. 2000).

¹⁴⁶ See *id.* at 680.

¹⁴⁷ See *id.* at 680 & n.3.

¹⁴⁸ *Id.* at 681.

¹⁴⁹ See generally GEORGE W. COX, *ALIEN SPECIES IN NORTH AMERICA AND HAWAII: IMPACTS ON NATURAL ECOSYSTEMS* (1999); CHARLES S. ELTON, *THE ECOLOGY OF INVASIONS BY ANIMALS AND PLANTS* (1958); MARK WILLIAMSON, *BIOLOGICAL INVASIONS* (1996); Andrew N. Cohen & James T. Carlton, *Accelerating Invasion Rate in a Highly Invaded Estuary*, 279 *SCI.* 555 (1998); David M. Lodge, *Biological Invasions: Lessons for Ecology*, 8 *TRENDS IN ECOLOGY & EVOLUTION* 133 (1993).

¹⁵⁰ See, e.g., ROBERT DEVINE, *ALIEN INVASION: AMERICA’S BATTLE WITH NON-NATIVE ANIMALS AND PLANTS* 134–36 (1998); WILLIAMSON, *supra* note 149, at 77, 139–49; Julie A. Savidge, *Extinction of an Island Forest Avifauna by an Introduced Snake*, 68 *ECOLOGY* 660 (1987); Don C. Schmitz & Daniel Simberloff, *Biological Invasions: A Growing Threat*, *ISSUES IN SCI. & TECH.*, Summer 1997, at 33, 35; Eric Biber, Note, *Exploring Regulatory Options for Controlling the Introduction of Non-Indigenous Species to the United States*, 18 *VA. ENVTL. L.J.* 375, 380 (1999).

¹⁵¹ McCann, *supra* note 12, at 232. See generally Mark Williamson & Alastair Fitter,

The invasions that do succeed in triggering drastic ecological change often carry severe economic consequences.¹⁵² As overall biological diversity decreases, the environmental impact of invasive species will almost surely increase. If biologically “simplified communities are more vulnerable to invasion,” then “we should also expect an increase in frequency of successful invaders as well as an increase in their impact.”¹⁵³ Repeated cycles of extirpation and invasion, whether intentional or inadvertent, “can, and eventually will, invoke major shifts in community structure and dynamics.”¹⁵⁴

Other decisions likewise ignore advances in conservation biology and other scientific fields bearing on environmental policy. Federal courts routinely decline to treat conservation biology as “a necessary element of diversity analysis.”¹⁵⁵ In a case assailing the government’s failure to consider “population dynamics, species turnover, patch size, recolonization problems, fragmentation problems, edge effects, and island biogeography,”¹⁵⁶ the Seventh Circuit ultimately held that these concepts of conservation biology were “uncertain in application” and that the Forest Service could therefore ignore them in managing national forests.¹⁵⁷ Even a valid “general theory,” the court held, “does not translate into a management tool unless one can apply it to a concrete situation.”¹⁵⁸ A federal district court similarly declined to endorse specific techniques for managing “distinct geographic ecosystems . . . inhabited by grizzly bears.”¹⁵⁹ That court seemed to treat complexity as an inherent legal excuse for inaction. The possibility that “science or circumstances [might] . . . change[],” the court reasoned, relieved the agency of any obligation to prepare an “exhaustively detailed recovery plan.”¹⁶⁰ As a result, the court rejected a claim that the ESA required “linkage zones between ecosystems inhabited by grizzlies.”¹⁶¹

As these decisions demonstrate, environmental law demands that “a reviewing court must generally be at its most deferential” when an agency “is making predictions, within its area of special expertise, at the frontiers of science.”¹⁶² More than most other areas of legal endeavor, environmental

The Varying Success of Invaders, 77 *ECOLOGY* 1661 (1996).

¹⁵² See UNITED STATES OFFICE OF TECHNOLOGY ASSESSMENT, HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES 63–69 (1993); David Pimentel et al., *Environmental and Economic Costs of Nonindigenous Species in the United States*, 50 *BIOSCI.* 53 (2000).

¹⁵³ McCann, *supra* note 12, at 233.

¹⁵⁴ *Id.*

¹⁵⁵ *Sierra Club v. Marita*, 46 F.3d 606, 620 (7th Cir. 1995).

¹⁵⁶ *Id.* at 618.

¹⁵⁷ *Id.* at 621.

¹⁵⁸ *Id.* at 623.

¹⁵⁹ *Fund for Animals v. Babbitt*, 903 F. Supp. 96, 106 (D.D.C. 1995).

¹⁶⁰ *Id.* at 107.

¹⁶¹ *Id.* at 109–10.

¹⁶² *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 103

law “involves policy determinations in which the agency is acknowledged to have expertise.”¹⁶³ After all, the “principal purpose” of limitations on judicial review is “to avoid judicial entanglement in abstract policy disagreements which courts lack both expertise and information to solve.”¹⁶⁴ But review of administrative decisions routinely requires judges to “acquire the learning pertinent to complex technical questions in such fields as economics, science, technology and psychology.”¹⁶⁵ Judges “should not automatically succumb” to the “acknowledged expertise” of the agencies they review, “overwhelmed as it were by the utter ‘scientificity’” of the regulatory process.¹⁶⁶ “Restraint, yes, abdication, no.”¹⁶⁷

By the same token, the federal judiciary is not the sole forum in which biodiversity policy can—or should—be shaped. In practice, an extremely important measure for conserving critical habitat grows out of an exception to section 9 of the Endangered Species Act.¹⁶⁸ Section 10, as amended in 1982,¹⁶⁹ authorizes a landowner who would otherwise violate section 9 to receive an incidental take permit upon submission and approval of a habitat conservation plan (“HCP”).¹⁷⁰ In turn, approval of an HCP triggers the federal government’s obligation under section 7 to “insure that any action” it undertakes “is not likely to jeopardize the contin-

(1983); *see also* *Indus. Union Dep’t v. Am. Petroleum Inst.*, 448 U.S. 607, 656 (1980) (plurality opinion); *id.* at 705–06 (Marshall, J., dissenting); *Int’l Fabricare Inst. v. EPA*, 972 F.2d 384, 389 (D.C. Cir. 1992) (“The rationale for deference is particularly strong when the [agency] is evaluating scientific data within its technical expertise.”); *Envtl. Def. Fund, Inc. v. Costle*, 578 F.2d 337, 339 (D.C. Cir. 1978) (“[I]n an area characterized by scientific and technological uncertainty[,] . . . this court must proceed with particular caution, avoiding all temptation to direct the agency in a choice between rational alternatives.”); *Alliance for Bio-Integrity v. Shalala*, 116 F. Supp. 2d 166, 177 (D.D.C. 2000).

¹⁶³ *Time Warner Entm’t. Co. v. FCC*, 56 F.3d 151, 163 (D.C. Cir. 1995) (per curiam); *accord WorldCom, Inc. v. FCC*, 238 F.3d 449, 458 (D.C. Cir. 2001).

¹⁶⁴ *Norton v. S. Utah Wilderness Alliance*, 124 S. Ct. 2373, 2381 (2004).

¹⁶⁵ *Ethyl Corp. v. EPA*, 541 F.2d 1, 69 (D.C. Cir. 1976) (en banc) (Leventhal, J., concurring), *cert. denied*, 426 U.S. 941 (1976); *cf.* *Kassel v. Consol. Freightways Corp.*, 450 U.S. 662, 670 (1981) (plurality opinion) (expressing a willingness to invalidate “marginally” effective and “substantially” obtrusive state laws despite state officials’ claimed expertise over regulations designed “to promote the public health or safety”).

¹⁶⁶ *Essex Chem. Corp. v. Ruckelshaus*, 486 F.2d 427, 434 (D.C. Cir. 1973).

¹⁶⁷ *Ethyl Corp.*, 541 F.2d at 69 (Leventhal, J., concurring).

¹⁶⁸ *See* 16 U.S.C. § 1532(5)(A) (2000) (defining “critical habitat” as “the specific areas within the geographical area occupied by” a species at such time it is listed as threatened or endangered, “on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection”); 16 U.S.C. § 1533(a)(3)(A) (mandating the designation of “critical habitat” for endangered or threatened species).

¹⁶⁹ *See* Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, § 6, 96 Stat. 1411, 1422–24 (1982).

¹⁷⁰ *See* 16 U.S.C. § 1539(a) (2000); *Babbitt v. Sweet Home Chapter of Communities for a Great Or.*, 515 U.S. 687, 691 (1995). Notwithstanding the ESA’s general prohibition against the “tak[ing]” of any endangered “species within the United States or the territorial sea of the United States,” 16 U.S.C. § 1538(a)(1)(B) (2000), the Secretary of the Interior or of Commerce “may permit” such a taking if it “is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.” 16 U.S.C. § 1539(a)(1)(B).

ued existence of any endangered species or threatened species or result in the destruction or adverse modification” of critical habitat.¹⁷¹ Beginning with efforts to reconcile preservation of the remaining habitat of the endangered Mission Blue butterfly with commercial development on San Bruno Mountain on the San Francisco peninsula,¹⁷² the ESA’s enforcing agencies have interpreted section 7 as imposing an affirmative obligation to pursue an active species conservation policy.¹⁷³ Clinton-era enforcement thereby converted section 10’s “previously obscure and rarely used permit provision” into “the centerpiece of . . . endangered species and ecosystem conservation policy.”¹⁷⁴

Section 10 enforcement has transformed section 9’s nominally invariant rule into a “penalty default” rule, a legal baseline intentionally designed to be sufficiently unpleasant to spur affected parties into negotiating more favorable alternatives.¹⁷⁵ By overcoming objections to the supposed rigidity of the ESA, HCPs represent “perhaps the most visible example of a consensus-based, multi-stakeholder approach to resource management.”¹⁷⁶ They have transformed the ESA into “the opening gambit in a prolonged bargaining process.”¹⁷⁷

¹⁷¹ 16 U.S.C. § 1536(a)(2) (2000); see also 50 C.F.R. § 402.01(b) (2004); *Friends of Endangered Species, Inc. v. Jantzen*, 760 F.2d 976, 984–85 (9th Cir. 1985); *Nat’l Wildlife Fed. v. Babbitt*, 128 F. Supp. 2d 1274, 1286 (E.D. Cal. 2000).

¹⁷² See *Friends of Endangered Species, Inc.*, 760 F.2d at 982–83; S. REP. NO. 97-418, at 10 (1982); H.R. REP. NO. 97-835, at 31–32 (1982); MICHAEL J. BEAN ET AL., *RECONCILING CONFLICTS UNDER THE ENDANGERED SPECIES ACT: THE HABITAT CONSERVATION PLANNING EXPERIENCE* 52–55 (1991); Jamie A. Grodsky, *The Paradox of (Eco)Pragmatism*, 87 MINN. L. REV. 1037, 1058–59 & n.81 (2003), reprinted in *JURISDYNAMICS*, *supra* note 121, at 95, 104, 114–15; Albert C. Lin, *Participants’ Experiences with Habitat Conservation Plans and Suggestions for Streamlining the Process*, 23 *ECOLOGY L.Q.* 369, 375–76 (1996).

¹⁷³ See *Carson-Truckee Water Conservancy Dist. v. Clark*, 741 F.2d 257, 262 (9th Cir. 1984); *Fla. Key Deer v. Stickney*, 864 F. Supp. 1222, 1237–38 (S.D. Fla. 1994); J. B. Ruhl, *Section 7(a)(1) of the “New” Endangered Species Act: Rediscovering and Redefining the Untapped Power of Federal Agencies’ Duty to Conserve Species*, 25 *ENVTL. L.* 1107, 1137 (1995).

¹⁷⁴ Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism*, 87 MINN. L. REV. 943, 970 (2003), reprinted in *JURISDYNAMICS*, *supra* note 121, at 51, 64.

¹⁷⁵ See Ian Ayres & Robert Gertner, *Filling Gaps in Incomplete Contracts: An Economic Theory of Default Rules*, 99 *YALE L.J.* 87, 94 (1989); Randy E. Barnett, *The Sound of Silence: Default Rules and Contractual Consent*, 78 *VA. L. REV.* 821, 825 (1992); Stephen J. Ware, *Default Rules from Mandatory Rules: Privatizing Law Through Arbitration*, 83 *MINN. L. REV.* 703, 706 (1999).

¹⁷⁶ Jody Freeman, *The Contracting State*, 28 *FLA. ST. U. L. REV.* 155, 194 (2000). *But cf.* Karin P. Sheldon, *Habitat Conservation Planning: Addressing the Achilles Heel of the Endangered Species Act*, 6 *N.Y.U. ENVTL. L.J.* 279 (1998) (arguing that landowners historically did not treat incidental take permits under § 10(a) as a sufficiently serious prospect to propose the implementation of HCPs).

¹⁷⁷ Daniel A. Farber, *Taking Slippage Seriously: Noncompliance and Creative Compliance in Environmental Law*, 23 *HARV. ENVTL. L. REV.* 297, 316–17 (1999). For further discussion of environmental law as a process of public-sector negotiation among interested groups, see generally David A. Dana, *The New “Contractarian” Paradigm in Environmental Regulation*, 2000 *U. ILL. L. REV.* 35 (2000); Grodsky, *supra* note 172.

III. RECONCILING STORIES OF ORIGINS WITH HUMAN DESTINY

For all its foibles, American law does take some practical steps toward slowing civilization's destruction of the biosphere. Two of the United States' leading environmental statutes, NEPA and the Endangered Species Act, play the role that explicitly environmental provisions play in the constitutional law of other nations. Part II's somewhat elaborate look into certain aspects of NEPA and ESA enforcement should not obscure these super-statutes' greater significance within the overarching structure of an environmentally conscious system of governance. The vitality of that system depends, in turn, on the larger public's understanding of environmental science and the government's willingness to advance that understanding. Alas, the American public is in fact quite biologically illiterate, especially with respect to the evolutionary basis of natural history and the significance of environmental law in a time of mass extinctions. A single jurist, Justice Antonin Scalia, has inflamed political passions that undermine efforts to counteract biological illiteracy in the United States.

Part III will now turn to three related tasks. First, it will illustrate the prevalence of biological illiteracy throughout American culture. Second, it will lament how this uniquely American brand of willful ignorance perverts religion, law, and politics in the United States. Finally, Part III will condemn Justice Scalia's singular contribution to this shameful state of affairs.

A. *Think Globally, Act Nationally*

Practical measures such as NEPA and the ESA do delay the progress of our ongoing ecological catastrophe. Symbolic gestures and public attitudes toward the environment also matter. Effective environmental protection depends on "learning strategies" that enable policymakers not only to withstand a "high degree of uncertainty" but also to absorb "our rapidly evolving understanding" of the science underlying environmental problems and their solutions.¹⁷⁸ Nowhere is a commitment to environmental learning more important than in the United States, which more than any other lone nation-state commands the resources and the influence to steer global environmental policy away from the apocalyptic edge on which it now teeters. In a world whose "environmental interconnection has become too real to ignore," no single nation can seek refuge in localism, even on a continental scale, from its responsibility to engage "transboundary communities" and the environmental problems that transcend political boundaries.¹⁷⁹ Despite its global leadership on endangered species protection, the United States has abdicated its opportunity to influence

¹⁷⁸ Daniel A. Farber, *Environmental Protection as a Learning Experience*, 27 *LOY. L.A. L. REV.* 791, 806 (1994).

¹⁷⁹ Farber, *supra* note 92, at 1271.

international agreements such as the Convention on Biological Diversity¹⁸⁰ and the Kyoto Protocol.¹⁸¹

As the environmentalist slogan counsels, America should think globally and act locally. Any realistic prospect of reclaiming the United States' international leadership on environmental issues might begin with revitalization of America's own Endangered Species Act. This statute enjoys no presumption of continued political support. If anything, the ESA has become the principal lightning rod in American environmental law. It serves as a channel for diverse political anxieties and as a venue for vociferous opposition to robust environmental protection. Thanks to appalling biological illiteracy within the populace and even in the judiciary, America's greatest legal contribution to biodiversity conservation clings by an uncomfortably narrow margin. In 1989, Justice White took pains to dissent from the denial of certiorari in a petition raising the rhetorically potent if legally vacant "claim that the Endangered Species Act operates as a governmental authorization of a 'taking' of [private] property."¹⁸² Justice White speculated that prohibiting a rancher from killing grizzly bears that threaten livestock might unconstitutionally "'forc[e] some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole.'"¹⁸³

When the related question of applying the ESA to destruction of an endangered species' critical habitat reached the Court in *Sweet Home*, Justice Antonin Scalia embraced and even extended Justice White's attack on the ESA. In a bitter dissent for himself and two other members of the Court, Justice Scalia accused the majority of "impos[ing] unfairness to the point of financial ruin—not just upon the rich, but upon the simplest farmer who finds his land conscripted to national zoological use."¹⁸⁴ Justice Scalia's posture toward endangered species protection has given rise to many judicial oddities. In a unanimous opinion for the Court, Scalia took pains to deemphasize "the ESA's overall goal of species preservation" relative to the "readily apparent" value of "another objective (if not indeed the primary one)," namely, that of "avoid[ing] needless economic dislocation produced by agency officials zealously but unintelligently pursuing their environmental objectives."¹⁸⁵ Even more puzzling is

¹⁸⁰ U.N. CONFERENCE ON ENVIRONMENT AND DEVELOPMENT: CONVENTION ON BIOLOGICAL DIVERSITY, June 5, 1992, 1760 U.N.T.S. 142.

¹⁸¹ U.N. Framework Convention on Climate Change, *Kyoto Protocol*, U.N. Doc. FCCC/CP/1997/L.7/Add.1 (Dec. 10, 1997); see also U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, May 9, 1992, 1771 U.N.T.S. 164 (entered into force, Mar. 21, 1994).

¹⁸² *Christy v. Lujan*, 490 U.S. 1114, 1115 (1989) (White, J., dissenting from denial of cert.).

¹⁸³ *Id.* at 1116 (quoting *First English Evangelical Lutheran Church v. County of Los Angeles*, 482 U.S. 304, 318–19 (1987)); *Armstrong v. United States*, 364 U.S. 40, 49 (1960)).

¹⁸⁴ *Babbitt v. Sweet Home Chapter of Communities for a Great Or.*, 515 U.S. 687, 714 (1995) (Scalia, J., dissenting).

¹⁸⁵ *Bennett v. Spear*, 520 U.S. 154, 176–77 (1997).

Justice Scalia's utter refusal in *Sweet Home* to accommodate habitat destruction within an expansive reading of the statutory verb "take." When the same verb appears in the Constitution—specifically, in the Fifth Amendment's edict that "private property [not] be taken for public use, without just compensation"¹⁸⁶—Justice Scalia suddenly becomes the Court's leading proponent of a broad definition of the verb "take."¹⁸⁷ The textual incongruity defies comprehension, let alone explanation or justification.

B. Biological Illiteracy as the Genesis of the Environmental Crisis

Surprisingly enough, the *Sweet Home* dissent does not rank as Justice Scalia's most outlandish pronouncement on legal matters connected to biodiversity. That distinction belongs to a dissent from an otherwise routine denial of certiorari in a 2000 case styled *Tangipahoa Parish Board of Education v. Freiler*.¹⁸⁸ Justice Scalia's dissent in *Tangipahoa Parish* deserves condemnation because no other legal authority gives more aid and comfort to advocates of creationism. Stiff political opposition to the straightforward teaching of evolution is no joke; it is an enemy that the law must defeat in order to address what this Essay calls "the most significant problem facing the world." The persistence of a creationist narrative in the public understanding of natural history impedes genuine efforts to instill a productive sense of environmental ethics in American law and politics.

In *Tangipahoa Parish*, a Louisiana school board had declared that lessons on "the Scientific Theory of Evolution" would "be presented to inform students of the scientific concept and not . . . to influence or dissuade the Biblical version of Creation or any other concept."¹⁸⁹ The U.S. Court of Appeals for the Fifth Circuit duly invalidated the school board's disclaimer.¹⁹⁰ Public expressions challenging the scientific validity of the theory of evolution have no chance of withstanding the Supreme Court's leading decisions regarding legal efforts to restrict the teaching of evolution. *Epperson v. Arkansas*¹⁹¹ barred public schools from banning the teaching of evolution outright, and *Edwards v. Aguillard*¹⁹² invalidated a statute requiring the teaching of creationism alongside evolution.

Justice Scalia, however, derided the appeals court's reasoning—and, by extension, that of his colleagues who voted to deny the school board's

¹⁸⁶ U.S. CONST. amdt. V.

¹⁸⁷ See, e.g., *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1019 (1992); *Nollan v. Cal. Coastal Comm'n*, 483 U.S. 825, 837 (1987). See generally Laura S. Underkuffler, *Tahoe's Requiem: The Death of the Scalian View of Property and Justice*, 21 CONST. COMMENT. (forthcoming 2004–2005).

¹⁸⁸ 530 U.S. 1251 (2000).

¹⁸⁹ *Id.* at 1251 (Scalia, J., dissenting from denial of cert.).

¹⁹⁰ *Freiler v. Tangipahoa Parish Bd. of Educ.*, 185 F.3d 337, 348 (5th Cir. 1999), cert. denied, 530 U.S. 1251 (2000).

¹⁹¹ 393 U.S. 97 (1968).

¹⁹² 482 U.S. 578 (1987).

petition for certiorari—as “quite simply absurd.”¹⁹³ He found no reasonable prospect of treating the school board’s “reference to . . . a reality of religious literature” as an unconstitutional “establishment of religion.”¹⁹⁴ After expressing seeming disapproval of *Epperson* and *Edwards*, Justice Scalia berated his colleagues for advancing further “the much beloved secular legend of the Monkey Trial.”¹⁹⁵

Justice Scalia’s allusion to the 1925 prosecution of John Scopes for teaching evolution in a Tennessee high school¹⁹⁶ represented a transparent political appeal to the shockingly powerful lobby that opposes the teaching of evolution in American public schools.¹⁹⁷ Driven by Christian fundamentalists’ conviction that public acceptance of evolution would inevitably weaken religious faith, the antievolution campaign fueled by that case has hounded evolution and converted the central, organizing principle of the life sciences into a false emblem of putative conflict between science and religion.¹⁹⁸ Political attacks on the teaching of evolution abound in nearly every state legislature and even in Congress.¹⁹⁹ Tactics adopted by antievolution activists range from frontal attacks on the theory to “equal time” legislation demanding “balanced” treatment of evolution and creationism, disclaimers or warning labels on textbooks, and the removal of evolution from the science curriculum.²⁰⁰ Public school science standards across the country have bent in response to political pressure, invariably for the worse.²⁰¹

¹⁹³ *Tangipahoa Parish Bd. of Educ. v. Freiler*, 530 U.S. 1251, 1255 (Scalia, J., dissenting from denial of cert.).

¹⁹⁴ *Id.*

¹⁹⁵ *Id.*

¹⁹⁶ *See Scopes v. State*, 289 S.W. 363 (Tenn. 1927).

¹⁹⁷ *See generally* RAYMOND A. EVE & FRANCIS B. HARROLD, *THE CREATIONIST MOVEMENT IN MODERN AMERICA* (1991); Randy Moore, *America’s Anti-Evolution Movement*, *ACAD. QUESTIONS*, Spring 2002, at 69; Randy Moore, *The Revival of Creationism in the United States*, 35 *J. BIOLOGICAL EDUC.* 17 (2000); Eugenie C. Scott, *Creationism, Ideology, and Science*, in *THE FLIGHT FROM SCIENCE AND REASON* 505 (Paul R. Gross et al. eds., 1996).

¹⁹⁸ *See* Susan Jacoby, *Caught Between Church And State*, *N.Y. TIMES*, Jan. 19, 2005, at A19.

¹⁹⁹ *See generally* Jay D. Wexler, *Darwin, Design, and Disestablishment: Teaching the Evolution Controversy in Public Schools*, 56 *VAND. L. REV.* 751 (2003).

²⁰⁰ *See* Deborah A. Reule, *The New Face of Creationism: The Establishment Clause and the Latest Efforts to Suppress Evolution in Public Schools*, 54 *VAND. L. REV.* 2555, 2572–86 (2001).

²⁰¹ *See* SUSAN JACOBY, *FREETHINKERS: A HISTORY OF AMERICAN SECULARISM* 360–61 (2004); *cf. id.* at 250 (observing how southern school systems, especially in Texas, censor evolution in textbooks in deference to “a powerful religious right”); Cornelia Dean, *A New Screen Test for IMAX: The Bible vs. the Volcano*, *N.Y. TIMES*, Mar. 19, 2005, at A11 (reporting the reluctance of IMAX theater operators to display films referring to evolution or even the age of the Earth for fear of offending religiously conservative members of their audiences). *See generally* LAWRENCE S. LERNER, *GOOD SCIENCE, BAD SCIENCE: TEACHING EVOLUTION IN THE STATES* (2000), available at <http://www.edexcellence.net/doc/lerner.pdf> (last visited Feb. 27, 2005) (on file with the Harvard Environmental Law Review).

Justice Scalia's shameless pandering gives judicial aid and comfort of the highest order to the political lobby against the teaching of evolution. The most sophisticated of these activists—namely, advocates of “intelligent design,”²⁰² a thinly veiled form of proselytization on behalf of a religious account of human origins—routinely disparage the evolutionary account of natural history as “a creation myth.”²⁰³ Judicial pandering nourishes the “distinctively American” movement to suppress the teaching of evolution²⁰⁴ and thereby to propagate “an intellectually marginal and demographically minority view of religion” whose adherents “long to impose upon the entire world.”²⁰⁵ The antievolution movement is a political “incubus” known in “[n]o other Western nation”;²⁰⁶ repeated disputes over “the teaching of secularist science in . . . public schools” have come to “set[] the United States apart from all other developed nations.”²⁰⁷

The dissent in *Tangipahoa Parish* has revived a longstanding struggle that Justice Scalia has waged since dissenting from the Supreme Court's 1987 decision in *Edwards v. Aguillard*²⁰⁸ to invalidate a Louisiana statute prescribing “Balanced Treatment for Creation-Science and Evolution-Science in Public School Instruction.” The seven-Justice majority in *Edwards* concluded that the “Louisiana Creationism Act advances a religious doctrine by requiring either the banishment of the theory of evolution from public school classrooms or the presentation of a religious viewpoint that rejects evolution in its entirety.”²⁰⁹ Justice Scalia, dissenting, declared himself “astonished by the Court's unprecedented readiness” to invalidate Louisiana's statute.²¹⁰ “[O]n the evidence before” the Court, Justice Scalia was willing to credit “ample uncontradicted testimony that ‘creation science’ is a body of scientific knowledge rather than

²⁰² For sources refuting the claims made by “intelligent design,” see BARBARA FORREST & PAUL R. GROSS, *CREATIONISM'S TROJAN HORSE: THE WEDGE OF INTELLIGENT DESIGN* (2004); ROBERT T. PENNOCK, *TOWER OF BABEL: THE EVIDENCE AGAINST THE NEW CREATIONISM* (1999); NIAL SHANKS, *GOD, THE DEVIL, AND DARWIN* (2004); *INTELLIGENT DESIGN CREATIONISM AND ITS CRITICS* (Robert T. Pennock ed., 2001); *WHY INTELLIGENT DESIGN FAILS* (Matt Young & Taner Edis eds., 2004).

²⁰³ See, e.g., PHILLIP E. JOHNSON, *DARWIN ON TRIAL* 131 (1991) (“Darwinist evolution is an imaginative story about who we are and where we came from, which is to say it is a creation myth.”); MICHAEL DENTON, *EVOLUTION: A THEORY IN CRISIS* 358 (1986) (“Ultimately the Darwinian theory of evolution is no more or less than the great cosmogenic myth of the twentieth century.”).

²⁰⁴ STEPHEN JAY GOULD, *ROCKS OF AGES: SCIENCE AND RELIGION IN THE FULLNESS OF LIFE* 129 (1999).

²⁰⁵ *Id.* at 148–49.

²⁰⁶ *Id.* at 129.

²⁰⁷ JACOBY, *supra* note 201, at 128; see also Michelle Galley, *Evolution Theory Prevails in Most Western Curricula*, *EDUC. WEEK*, Jan. 28, 2004, at 8 (documenting the absence of controversy over the teaching of evolution in other Western countries).

²⁰⁸ 482 U.S. 578 (1987).

²⁰⁹ *Id.* at 596.

²¹⁰ *Id.* at 634 (Scalia, J., dissenting). Chief Justice Rehnquist joined Justice Scalia's dissent.

revealed belief.”²¹¹ He found no explanation for the majority’s contrary conclusion except what he called “an intellectual predisposition created by the facts and the legend of” the Scopes trial “—an instinctive reaction that any governmentally imposed requirements bearing upon the teaching of evolution must be a manifestation of Christian fundamentalist repression.”²¹² To Justice Scalia, the embrace of an elitist “*Scopes-in-reverse*” lay at the heart of the Supreme Court majority’s “illiberal judgment.”²¹³

Justice Scalia routinely makes overt references to his Christian faith in public settings,²¹⁴ but his dissents in *Tangipahoa Parish* and *Edwards* transgress the reasonable boundaries of judicial responsibility.²¹⁵ To use a phrase Justice Scalia has launched in another politically contentious context, Justice Scalia has taken his *Kulturkampf*²¹⁶ against “*Scopes-in-reverse*” one step too far. Shorn of the sheep’s clothing of “intellectual design” as pseudoscience, the vulpine antievolution movement comes as a wolf.²¹⁷ In a country whose politically powerful fringes, left and right alike, reject the Enlightenment and its dedication to reason over spiritually revealed truth,²¹⁸ enormous political value accompanies the battle to suppress a thoroughly researched and firmly established scientific principle without which “[n]othing in [b]iology [m]akes [s]ense.”²¹⁹

Creationism persists as a political movement in the United States precisely because it unites “a set of distinctively American contrasts . . . : North versus South, urban versus rural, rich versus poor, local or state control versus federal standards.”²²⁰ Imposing creationism on the public school curriculum enables a significant portion of the nonelite masses in rural and suburban America to strike a deep and symbolically powerful blow against the largely urban and secularist successors to the Progressives and other American heirs of the Enlightenment.²²¹ Religiously inclined Americans have long felt—and resented—the intellectual elite’s overt hostility

²¹¹ *Id.*

²¹² *Id.*

²¹³ *Id.*

²¹⁴ See generally Michael Stokes Paulsen & Steffen N. Johnson, *Scalia’s Sermonette*, 72 NOTRE DAME L. REV. 863 (1997).

²¹⁵ See generally David McGowan, *Judicial Writing and the Ethics of the Judicial Office*, 14 GEO. J. LEGAL ETHICS 509 (2001).

²¹⁶ Cf. *Romer v. Evans*, 517 U.S. 620, 636 (1996) (Scalia, J., dissenting) (“The Court has mistaken a *Kulturkampf* for a fit of spite.”). *Kulturkampf*, the German word for “culture war,” refers to a conflict between Chancellor Otto von Bismarck and the Vatican during the 1870s, when “a political storm” in the newly unified German Empire “centered on a series of repressive measures directed mainly against the Catholic church.” HELMUT WALSER SMITH, GERMAN NATIONALISM AND RELIGIOUS CONFLICT 19 (1995).

²¹⁷ Cf. *Morrison v. Olson*, 487 U.S. 654, 699 (1988) (Scalia, J., dissenting) (“[T]his wolf comes as a wolf.”).

²¹⁸ See Suzanna Sherry, *The Sleep of Reason*, 84 GEO. L.J. 453, 457–64 (1996).

²¹⁹ See Theodosius Dobzhansky, *Nothing in Biology Makes Sense Except in the Light of Evolution*, 35 AM. BIOLOGY TEACHER 125 (1973).

²²⁰ GOULD, *supra* note 204, at 129–30.

²²¹ See Edward J. Larson, *The Scopes Trial and the Evolving Concept of Freedom*, 85 VA. L. REV. 503 (1999).

toward religion.²²² The persistence of creationism in American law and politics represents a loathsome form of payback.

To date, the Enlightenment's commitment to empirical observation and the scientific method has not overcome a significant portion of the American public's evident preference to seek the truth (or at least a good measure of truth) through spiritual revelation. Abstract appeals to rule of law in general and to constitutional doctrine in particular have allegedly allowed "fundamentalist beliefs [to] remain unchallenged."²²³ Ordinary human beings use religion rather than common sense to "code ecological knowledge" because "religion involves emotions, involves the community, and reaches people in ways that logical, rational argument cannot."²²⁴ In a time of mass extinctions and other environmental catastrophes, the creationist narrative satisfies a deep human desire that the world should follow rules of order, especially those attributing disasters and loss to prior immorality.²²⁵ The impulse is understandable. It is also squarely wrong and deeply destructive.

In *Tangipahoa Parish*, Justice Scalia took umbrage at the idea that the law might "bar[] a school district from even suggesting to students that other theories besides evolution—including, but not limited to, the Biblical theory of creation—are worthy of their consideration."²²⁶ Yet his *Edwards* dissent had already demonstrated why laws restricting the teaching of evolution are unconstitutional, even if Justice Scalia could not bring himself to accept his own reasoning. Laws of the sort at issue in *Epperson*, *Edwards*, and *Tangipahoa Parish* are perhaps "unconstitutional because there is no . . . evidence" undermining the concept of evolution by natural and sexual selection, and contrary legal "scheme[s]" devised by evolution's political opponents have "amount[ed] to no more than a presentation of the Book of Genesis."²²⁷

Non-evolutionary hypotheses about the origins and history of life deserve no audience because they lack evidentiary support. Charles Darwin

²²² See, e.g., STEPHEN L. CARTER, *THE CULTURE OF DISBELIEF: HOW AMERICAN LAW AND POLITICS TRIVIALIZE RELIGIOUS DEVOTION* 1–11, 23–24 (1993) (noting widespread hostility to religion in most intellectual circles); Sanford Levinson, Book Review, *Religious Language and the Public Square*, 105 HARV. L. REV. 2061, 2062 (1992) (noting the relative lack of attention to "claims of exclusion and silencing made by those with strong religious commitments").

²²³ EDWARD J. LARSON, *SUMMER FOR THE GODS: THE SCOPES TRIAL AND AMERICA'S CONTINUING DEBATE OVER SCIENCE AND RELIGION* 260–61 (1997).

²²⁴ E. N. ANDERSON, *ECOLOGIES OF THE HEART: EMOTION, BELIEF, AND THE ENVIRONMENT* 111 (1996); see also Roy A. Rappaport, *The Sacred in Human Evolution*, 2 ANN. REV. ECOLOGY & SYSTEMATICS 23 (1971); Paul Slovic, *Rational Actors and Rational Fools: The Influence of Affect on Judgment and Decision-Making*, 6 ROGER WMS. U. L. REV. 163 (2000).

²²⁵ See Melvin J. Lerner & Dale T. Miller, *Just World Research and the Attribution Process: Looking Back and Ahead*, 85 PSYCHOL. BULL. 1030 (1978).

²²⁶ *Tangipahoa Parish Bd. of Educ. v. Freiler*, 530 U.S. 1251, 1255 (2000) (Scalia, J., dissenting from denial of cert.).

²²⁷ *Edwards v. Aguillard*, 482 U.S. 578, 634 (1987) (Scalia, J., dissenting).

himself spotted the overwhelming extent of the evidence favoring evolution, a balance that has become even more lopsided over time: “[i]t is incredible that all these facts should speak falsely.”²²⁸ From the fossil record to comparative anatomy, biogeography, the remarkably conservative nature of ontogeny and molecular biology, and antibiotic resistance in infectious bacteria, biology as a scientific enterprise has amassed staggering amounts of empirical evidence that supports evolution as a unifying, predictive principle that simplifies and clarifies our understanding of living things.²²⁹ This is “theory” in the truest scientific sense of the word, “an integrated explanation of a number of hypotheses, each supported by consistent results from many observations or experiments,” that “has withstood repeated testing and is almost universally accepted by scientists.”²³⁰ The baneful failure of nonscientists to distinguish the concept of a theory from that of a hypothesis inspires otherwise laughable but politically viable laws forcing science teachers to distinguish evolutionary “theory” from other biological “facts.”

A broad swath of the scientific curriculum hangs in the balance. The antievolutionist position rejects the role of evolution in speciation, diversification, paleontology, biogeography, and any number of other biological topics. Ecosystems, individual species, and biological mechanisms at the cellular and molecular level are all products of evolution and not of design. To paraphrase the claims that the Nicene Creed makes for the Son of God, living things and the processes that drive them are “begotten, not made.”²³¹ Absent scientific evidence, putative “alternatives” to the evolutionary account simply do not belong in public schools. Chronically marginal in an increasingly competitive global economy,²³² American schools cannot afford to waste time on unsupported accounts of natural history or, for that matter, to omit instruction on the central organizing principle of the life sciences. “Because knowledge of biology has increased exponentially” since controversy over the teaching of evolution exploded onto the American political scene, “antievolutionists have the potential to inflict

²²⁸ CHARLES DARWIN, *THE DESCENT OF MAN AND SELECTION IN RELATION TO SEX* 694 (2d ed. 1874).

²²⁹ See generally, e.g., SOLOMON ET AL., *supra* note 37, at 374–87.

²³⁰ *Id.* at 20.

²³¹ BERARD MARTHALER, *THE CREED: THE APOSTOLIC FAITH IN CONTEMPORARY THEOLOGY* 83 (rev. ed. 1993). The Nicene Creed is the most widespread succinct statement of the Christian faith. Ever since its adoption at the Council of Constantinople in 381 in response to Arianism, a fourth-century movement that denied the divinity of Christ, the Nicene Creed has remained religious common ground for the Roman Catholic Church, all of the Eastern Orthodox Churches, and to most Protestant denominations. With the salient exception of the Church of Jesus Christ of Latter-Day Saints, virtually every religious tradition calling itself Christian subscribes to the Nicene Creed. See *id.* at vi–vii, 9–13. See generally NICENE CHRISTIANITY: *THE FUTURE FOR A NEW ECUMENISM* (Christopher R. Seitz ed., 2001).

²³² See, e.g., *United States v. Lopez*, 514 U.S. 549, 621–22 (1995) (Breyer, J., dissenting).

much greater damage on schools today than they did in the past.”²³³ It is worth remembering that “the most important decision in [Supreme Court] history” rested on the emphatic rejection of an odious educational philosophy.²³⁴ In education today the concepts of creationism and so-called intelligent design have no place.²³⁵

Like a shameless huckster cowering in the masquerade of public religiosity,²³⁶ the creationist campaign undermines thoughtful efforts to sustain religion in a secular and scientifically sophisticated polity. Creationism perverts the Christian tradition. Enlightened Christian theologians and clerics have long distinguished between the Bible as historical narrative and the Bible as mythology.²³⁷ The obsession with evolution casts heavier emphasis on Genesis than on the Gospels, precisely the reverse of what Christian theology stresses. Even though both Jesus of Nazareth and Paul of Tarsus took pains to deemphasize the Pentateuch (which includes the scientifically incongruent opening chapters of Genesis),²³⁸ strangely enough very little political controversy arises from the teaching of biological principles that emphatically deny the truly central mysteries of the Christian faith. Contrary to Justice Scalia’s suggestion in a case having no direct connection with the creationism controversy, Christianity does not treat the virgin birth and resurrection of Jesus as mere “details upon which men and women who believe in a benevolent, omnipotent Creator and Ruler of the world are known to differ.”²³⁹ Those putative miracles are central to the very “divinity of Christ,”²⁴⁰ and no public school lesson on evolution could be as damaging to Christian belief as biology’s unequivocal refutation of female-to-male parthenogenesis and the revival of

²³³ JACOBY, *supra* note 201, at 361.

²³⁴ RICHARD KLUGER, *SIMPLE JUSTICE: THE HISTORY OF BROWN V. BOARD OF EDUCATION AND BLACK AMERICA’S STRUGGLE FOR EQUALITY* 714 (2d ed. 2004); *see also* BERNARD SCHWARTZ, *A HISTORY OF THE SUPREME COURT* 286 (1993) (claiming that *Brown v. Bd. of Educ.*, 347 U.S. 483 (1954), was at a minimum “the watershed constitutional case of the [twentieth] century”). *See generally, e.g.*, JAMES T. PATTERSON, *BROWN V. BOARD OF EDUCATION: A CIVIL RIGHTS MILESTONE AND ITS TROUBLED LEGACY* (2001); HUGH W. SPEER, *THE CASE OF THE CENTURY: A HISTORICAL AND SOCIAL PERSPECTIVE ON BROWN V. BOARD OF EDUCATION OF TOPEKA, WITH PRESENT AND FUTURE IMPLICATIONS* (1993).

²³⁵ *Cf. Brown v. Bd. of Educ.*, 347 U.S. 483, 495 (1954) (“[I]n the field of public education the doctrine of ‘separate but equal’ has no place.”).

²³⁶ *Cf. SINCLAIR LEWIS, ELMER GANTRY* (1927).

²³⁷ *See, e.g.*, JAMES BARR, *THE SCOPE AND AUTHORITY OF THE BIBLE* 7 (1980) (assigning “the entire (and supremely important) primeval story” of “creation, . . . Noah and the flood, and so on” to “the area of myth and legend” rather than the realm of “history”); *see also* GOULD, *supra* note 204, at 81–82 (reporting how the Vatican, in the half-century between Pius XII and John Paul II, eventually acknowledged how the “growth of data” and “refinement of theory” had made it impossible for evolution to “be doubted by people of goodwill and keen intellect”).

²³⁸ *See John 6:58* (“[T]his is the bread which came down from heaven, not such as the fathers ate and died.”); *Hebrews 1:1–2* (“In many and various ways God spoke of old to our fathers by the prophets; but in these last days he has spoken to us by a Son . . .”).

²³⁹ *Lee v. Weisman*, 505 U.S. 577, 641 (1992) (Scalia, J., dissenting).

²⁴⁰ *Id.*

dead flesh.²⁴¹ That contemporary activists should ignore these scientific principles and train all their ire instead on evolution is a central political enigma of a movement that places “sins of the flesh” at “the centre of Christian morality” and evidently forgets that “a cold, self-righteous prig who regularly goes to church may be far nearer to hell than a prostitute.”²⁴² The Christianity of the antievolution movement and of America’s religious right in general is quick to condemn, slow to forgive, and utterly unable to think. One must wonder what Jesus would really think of it. Anything is possible, one must surmise, in a political culture that has so transmogrified the Christian tradition as seemingly to deny the relevance of the Beatitudes²⁴³ and the Great Commandments²⁴⁴ to human existence after birth and before death.²⁴⁵

This is to say nothing of the very palpable prospect that a belief in creationism is intrinsically contrary to Christian doctrine and quite possibly a sin. The “hugely anthropocentric fallacy” that “nature conforms to the limitation of [human] imaginations” represents “a kind of idolatry” in its own right.²⁴⁶ It “make[s] the Creator in our own image.”²⁴⁷ The human eye, for example, deeply “dear to creationists” because it “is so exquisitely suited for its purpose . . . that no sequence of random variations acting over time would seem sufficient for its design,”²⁴⁸ turns out to be a classic illustration of evolutionary convergence in diverse biological taxa.²⁴⁹

²⁴¹ *But see* JOSEPH CAMPBELL, *THOU ART THAT: TRANSFORMING RELIGIOUS METAPHOR* 65 (2001) (“[The virgin birth of Jesus] is the myth of the birth of a great spiritual leader and it has nothing whatsoever to do with biology. Saying that, however, does not diminish but accents its religious significance.”).

²⁴² C. S. LEWIS, *MERE CHRISTIANITY* 80 (1943); *see also* *John* 8:7 (“Let him who is without sin among you be the first to throw a stone at her.”).

²⁴³ *See* *Matthew* 5:3–12; *Luke* 6:20–22.

²⁴⁴ *See* *Matthew* 22:36–40; *Mark* 12:29–31; *Luke* 10:25–28.

²⁴⁵ *Cf.* SAM PHILLIPS, *I Need Love, on MARTINIS & BIKINIS* (Virgin Records 1994) (“I need god / not the political church”). Perhaps the leading example of what I consider the vulgarization of the Christian tradition through constitutional adjudication and electoral politics in the United States is Justice Scalia’s astounding declaration that the Supreme Court’s invalidation of a poorly worded attempt to ban intact dilation and extraction “one day . . . will be assigned its rightful place in the history of th[e] Court’s jurisprudence beside *Korematsu* [v. United States, 323 U.S. 214 (1944)] and *Dred Scott* [v. Sandford, 60 U.S. (19 How.) 393 (1856)].” *Stenberg v. Carhart*, 530 U.S. 914, 953 (2000) (Scalia, J., dissenting). Fuller exposition of this assertion lies beyond the scope of this Essay. I will leave this project for another time and perhaps another scholar.

²⁴⁶ CHET RAYMO, *SKEPTICS AND TRUE BELIEVERS: THE EXHILARATING CONNECTION BETWEEN SCIENCE AND RELIGION* 150 (1998).

²⁴⁷ *Id.*

²⁴⁸ *Id.* at 148. For instances of creationist literature treating the human eye as evidence against evolution, *see* I. L. COHEN, *DARWIN WAS WRONG* 116 (1984) (“It is not possible, under any stretch of the imagination, that all [the] parts of the [human eye’s] optical mechanisms could haphazardly become functional through random mutations.”); MICHAEL PITMAN, *ADAM AND EVOLUTION* 217 (1984) (“The eye must be perfect or near perfect. Otherwise, it is useless.”).

²⁴⁹ *See* Russell D. Fernald, *The Evolution of Eyes*, 50 *BRAIN BEHAV. EVOLUTION* 253 (1997). *See generally* SIMON CONWAY MORRIS, *LIFE’S SOLUTION: INEVITABLE HUMANS IN A LONELY UNIVERSE* (2003) (describing the tendency of random variations to converge on

Random mutation impels the emergence of a visual organ from light-sensitive cells in simple organisms.²⁵⁰ Computer models demonstrate that the evolution of an eye from an eyespot is “swift and decisive.”²⁵¹ Even if creationists have clouded their own eyes, those organs testify to the natural phenomenon they deny. Indeed, refusing to accept evidence of evolution because one lacks the skills to perceive or interpret that evidence merits a name of its own. Richard Dawkins dubs it the “Argument from Personal Incredulity.”²⁵² By contrast, both traditional religion and modern science at their best promise to “lead the blind in a way that they know not.”²⁵³

Within the ethical system of the Judeo-Christian tradition, the presence of overwhelming scientific evidence to the contrary generates an obligation to reject creationism. The Hebrew Bible prescribes a condign task for a human species equipped with knowledge of good and of evil: “cursed is the ground because of you; in toil you shall eat of it all the days of your life; thorns and thistles it shall bring forth to you; and you shall eat the plants of the field.”²⁵⁴ The Gospels similarly condemn those who fail to develop their abilities, however limited, to their fullest potential.²⁵⁵ The Cornwall Declaration on Environmental Stewardship, a joint declaration of Jewish, Catholic, and Protestant authorities, urges “the stewardship of human and ecological relationships” according to “sound theology and the careful use of scientific methods.”²⁵⁶ Shakespeare’s Prince of Denmark synthesized these precepts in memorable fashion:

What is a man
 If his chief good and market of his time
 Be but to sleep and feed? A beast, no more.
 Sure he that made us with such large discourse,
 Looking before and after, gave us not
 That capability and god-like reason
 To fust in us unused.²⁵⁷

similar solutions over the course of evolution).

²⁵⁰ See Dan-E. Nilsson & Susanne Pelger, *A Pessimistic Estimate of the Time Required for an Eye to Evolve*, 256 *PROC. ROYAL SOC’Y LONDON B.* 53 (1994).

²⁵¹ Richard Dawkins, *The Eye in a Twinkling*, 368 *NATURE* 690, 691 (1994).

²⁵² RICHARD DAWKINS, *THE BLIND WATCHMAKER: WHY THE EVIDENCE OF EVOLUTION REVEALS A UNIVERSE WITHOUT DESIGN* 38 (1986).

²⁵³ *Isaiah* 42:16.

²⁵⁴ *Genesis* 3:17–18.

²⁵⁵ See *Matthew* 25:14–30.

²⁵⁶ ENVIRONMENTAL STEWARDSHIP IN THE JUDEO-CHRISTIAN TRADITION: JEWISH, CATHOLIC, AND PROTESTANT WISDOM ON THE ENVIRONMENT, at xv (Michael B. Barkey ed., 2000).

²⁵⁷ WILLIAM SHAKESPEARE, *HAMLET*, act 4, sc. 4, ll. 33–39 (Robert Hapgood ed., Cambridge University Press 1999) (1603).

Biological ignorance is rampant in the United States. Nearly half the American public rejects the evolutionary account of natural history.²⁵⁸ Ours is a country whose president believes “the jury is still out” on the validity of evolution.²⁵⁹ Roughly “two-thirds of the public believe that alternatives to Darwin’s theory of evolution should be taught in public schools.”²⁶⁰ (Much of this public support, to be sure, arises from an apparent postmodern willingness to accommodate different beliefs rather than affirmative credence in a divine or other supernatural agent in biological origins.)²⁶¹ A University of Texas study found that one of three public school biology teachers thought it possible that humans and dinosaurs might have lived simultaneously.²⁶² With teachers like these, and in a political culture where only diehard partisans and offended scientists know the term “intelligent design,”²⁶³ political deception and judicial pandering can run amok. Relative to their counterparts in other wealthy nations, Americans are more than twice as likely to believe in the devil (68%) and three times as likely to believe in the virgin birth of Jesus (83%) as in evolution (28%).²⁶⁴ The presence of this politically potent majority should carry no legal weight. Suggestions to the contrary, even if couched in elegant prose and deemed worthy of a Pulitzer Prize,²⁶⁵ are nothing more than apologies for the teaching of nonsense. The law should assign no normative credit to poll findings that “a significant majority of the American public [think] creation science should be taught if evolution was taught,” for “[t]he application and content of First

²⁵⁸ See Eugenie C. Scott, *Antievolution and Creationism in the United States*, 26 ANN. REV. ANTHROPOLOGY 263, 263–64 (1997) (reporting a 1996 survey conducted by the National Science Board that found that 44% of Americans do not believe in an evolutionary explanation of human origins).

²⁵⁹ Peter Slevin, *Battle on Teaching Evolution Sharpens*, WASH. POST, Mar. 14, 2005, at A1.

²⁶⁰ William J. Broad & James Glanz, *Does Science Matter?*, N.Y. TIMES, Nov. 11, 2003, at F12; see also James Glanz, *Survey Finds Support Is Strong for Teaching 2 Origin Theories*, N.Y. TIMES, Mar. 11, 2000, at A1 (reporting poll results finding “that 79 percent of Americans thought creationism had a place in the public school curriculum,” albeit “as a belief rather than as a competing scientific theory”). See generally Deborah Jordan Brooks, *Substantial Numbers of Americans Continue to Doubt Evolution as Explanation for Origin of Humans*, GALLUP POLL MONTHLY, Mar. 2001, at 9.

²⁶¹ See PEOPLE FOR THE AMERICAN WAY FOUNDATION, *EVOLUTION AND CREATIONISM IN PUBLIC EDUCATION: AN IN-DEPTH READING OF PUBLIC OPINION 48* (2000), available at http://www.pfaw.org/pfaw/dfiles/file_36.pdf.

²⁶² See GEORGE E. WEBB, *THE EVOLUTION CONTROVERSY IN AMERICA* 254 (1994).

²⁶³ See George Bishop, *Intelligent Design*, PUB. PERSP., May/June 2003, at 7 (reporting that the vast majority of the public has no idea what the term “intelligent design” means and that polls using that term are accordingly suspect).

²⁶⁴ See Nicholas D. Kristof, *God, Satan and the Media*, N.Y. TIMES, Mar. 4, 2003, at A27 (devil); Nicholas D. Kristof, *Believe It, or Not*, N.Y. TIMES, Aug. 15, 2003, at A29 (virgin birth). One suspects that the disparity between the 28% figure reported by Kristof and the 44% figure reported by Scott, *supra* note 258, reflects a “mushy middle.” Some 28% of the American public believes in evolution; 44% rejects it. The balance apparently either does not know or will not say what it believes.

²⁶⁵ See LARSON, *supra* note 223, at 258, 304 n.27 (stressing the number of Americans who believe in a creationist account of natural history). SUMMER FOR THE GODS won the 1998 Pulitzer Prize for History.

Amendment principles are not determined by public opinion polls or by a majority vote.”²⁶⁶

And then there is the question of human destiny—specifically, the astonishingly popular suggestion that “the end is nigh.” An extraordinary percentage of the American public believes that the world is approaching or has entered the “end times” supposedly portrayed by a literal interpretation of the Book of Revelations.²⁶⁷ The twelve novels in the “Left Behind” series by Tim LaHaye and Jerry B. Jenkins have sold an astonishing 42 million copies from 1995 through 2004,²⁶⁸ undoubtedly appealing to the 40% of Americans (including 49% of Southerners) who believe that “the physical world will eventually end . . . as a result of some type of supernatural intervention.”²⁶⁹ At an extreme, believers in the imminence of the Apocalypse might even support the further despoliation of the environment with the expectation that the collapse of civilization will somehow hasten the second coming of Christ.²⁷⁰ In a society that enjoys the scientific sophistication needed to support an effective system of environmental ethics, the idea of living through the sixth great mass extinction in natural history should be apocalyptic enough.

Seen in the light of creationism’s slow but persistent growth from a “risible stalking horse[]” into a potentially “powerful champion[] of darkness,”²⁷¹ Justice Scalia’s gratuitous swipes at evolutionary biology in *Edwards*²⁷² and *Tangipahoa Parish*²⁷³ may be the most scientifically irresponsible passages in the *United States Reports*. For sheer stupidity and public recklessness, Justice Scalia’s sarcastic reference to legal efforts to keep evolution in public school classrooms as a “secular legend” may actually eclipse Justice Oliver Wendell Holmes’s eugenicist epithet, “Three generations of imbeciles are enough.”²⁷⁴ Even if Justice Scalia’s comments are construed as disparaging advocacy on behalf of efforts to teach evolution rather than disputing the validity of the theory itself,²⁷⁵ his dissents

²⁶⁶ *McLean v. Arkansas Bd. of Educ.*, 529 F. Supp. 1255, 1274 (E.D. Ark. 1982). For a riveting first-hand account of *McLean*, see LANGDON GILKEY, CREATIONISM ON TRIAL: EVOLUTION AND GOD AT LITTLE ROCK (1985).

²⁶⁷ Gayle White, *Countdown to the End Times: The World’s Demise Gets Lots of Ink—and Debate*, ATLANTA J.-CONST., May 17, 2003, at B2.

²⁶⁸ See Richard N. Ostling, *Best Sellers Distort Christianity*, ALBANY (N.Y.) TIMES UNION, Apr. 18, 2004, at A13. See generally Jennifer Robison, *Americans Find Religion on Bookstore Shelves*, GALLUP POLL MONTHLY, Jan. 2003, at 3.

²⁶⁹ White, *supra* note 267, at B2.

²⁷⁰ See Bill Moyers, *On Receiving Harvard Med’s Global Environment Citizen Award*, available at http://www.truthout.org/docs_04/120504G.shtml (last visited Feb. 20, 2005) (on file with the Harvard Environmental Law Review); Bill Moyers, *There Is No Tomorrow*, MINNEAPOLIS STAR-TRIB., Jan. 30, 2005.

²⁷¹ GOULD, *supra* note 204, at 149.

²⁷² *Edwards*, 482 U.S. at 634 (Scalia, J., dissenting).

²⁷³ *Tangipahoa Parish*, 530 U.S. at 125 (Scalia, J., dissenting from denial of cert.).

²⁷⁴ *Buck v. Bell*, 274 U.S. 200, 207 (1927). See generally STEPHEN JAY GOULD, *THE MEASURE OF MAN* (rev. ed. 1996).

²⁷⁵ *Cf. Edwards*, 482 U.S. at 621 (Scalia, J., dissenting) (stressing that Justice Scalia

in *Edwards* and *Tangipahoa Parish* have inflicted serious damage on the cause of biological literacy. Surely we should regret, even if Justice Scalia himself does not, the judiciary's loss of credibility on questions of law that should be informed by science.

IV. THE LEGAL ART AND ENVIRONMENTAL ETHICS OF BEAUTY

To assert that questions of environmental policy should be settled by science is not to deny a place for myth, mysticism, and beauty. "My work always tried to unite the true with the beautiful," said the physicist Hermann Weyl, "but when I had to choose one or the other, I usually chose the beautiful."²⁷⁶ Or, as John Keats expressed the point, "'Beauty is truth, truth beauty,'—that is all / Ye know on earth, and all ye need to know."²⁷⁷ Biodiversity conservation and environmental protection more generally are fields "so vast that fully to comprehend [them] would require an almost universal knowledge ranging from geology, biology, chemistry and medicine to the niceties of the legislative, judicial and administrative processes of government."²⁷⁸ Those fields of knowledge also include religion, the arts, and human emotion.

Among creation myths vying to satisfy the human need for a compelling story of origins, especially in an emotionally challenging "age of globalization," "none is more solid and unifying for the species than evolutionary history."²⁷⁹ No other story of beginnings boasts a grander narrative scope or enjoys greater scientific support. At least if studied across the whole of time, natural history represents "a form of modern 'creation myth'" that "reflects the best attempts of our society to answer questions about origins."²⁸⁰ Although "science and religion" are indeed "two domains hold[ing] equal worth and necessary status for any complete human life," they must "remain logically distinct and fully separate."²⁸¹ The "institution that we have named 'science'" represents "a teaching authority dedicated to using the mental methods and observational techniques validated by success and experience . . . for describing, and attempting to explain, the factual construction of nature."²⁸² The distinct problem of resolving "moral issues about the value and meaning of life," in human

"by no means intend[ed] to endorse [the] accuracy" of legislative testimony regarding "creation science," since his "views (and the views of this Court) about creation science and evolution" have no bearing in a Court whose task "is not to judge the debate about teaching the origins of life, but to ascertain what the members of the Louisiana Legislature believed").

²⁷⁶ EDWARD O. WILSON, *BIOPHILIA* 61 (1984) (quoting Hermann Weyl).

²⁷⁷ JOHN KEATS, *Ode on a Grecian Urn*, in *ODE ON A GRECIAN URN, THE EVE OF ST. AGNES AND OTHER POEMS* 14, ll. 49–50 (Houghton Mifflin 1901) (1820).

²⁷⁸ *Queensboro Farms Prods., Inc. v. Wickard*, 137 F.2d 969, 975 (2d Cir. 1943) (making this claim in the context of agricultural regulation, specifically of the dairy industry).

²⁷⁹ WILSON, *supra* note 132, at 133.

²⁸⁰ David Christian, *The Case for "Big History"*, 2 J. WORLD HIST. 223, 235 (1991).

²⁸¹ GOULD, *supra* note 204, at 58–59.

²⁸² *Id.* at 54.

form and otherwise, “must proceed under a different magisterium . . . dedicated to a quest for consensus, or at least a clarification of assumptions and criteria, about ethical ‘ought,’ rather than a search for any factual ‘is.’”²⁸³ In the first instance, humanity should look to natural history for its story of origins and for other insights on universals binding the entire human family despite its rocky political history and its contemporary cultural diversity. Each distinct interpretive community must then master “the mystery hidden for ages” and, in the idiom of its own ethical or religious tradition, make that magic “manifest to [the] saints” of each new generation.²⁸⁴

Since “evolution has produced sentient species with a sense of purpose,” we may defensibly explore “the connections that might . . . reunify the scientific world-view with the religious instinct.”²⁸⁵ Where, then, might we start? Thanks to the intellectual “consilience” that evolution provides to science and to all human endeavors informed by science,²⁸⁶ almost any episode in natural history can serve the vital function of “integrating the insights” of science and moral discourse “to build the rich and full view of life traditionally designated as wisdom.”²⁸⁷ Consider the following line of discoveries, all since 1999, that promise insight into the connections across all three domains of life: Archaea, Bacteria, and Eukarya.²⁸⁸ Microbiology has conventionally treated viruses as unrelated families, each specializing in hosts from a different domain of life. The conventional view distinguishes, for instance, between bacteriophages (viruses that infect bacteria) and viruses that exploit host cells within Animalia or some other eukaryotic kingdom.²⁸⁹ In 1999, X-ray crystallography revealed striking similarities between P3, the major coat protein of the bacteriophage PRD1, and hexon, the major coat protein of human adenovirus.²⁹⁰ Studies published in 2004 have extended these similarities to coat proteins in viruses infecting archaeobacteria, including a hyperthermophilic

²⁸³ *Id.* at 55; cf. Karl N. Llewellyn, *Some Realism About Realism—Responding to Dean Pound*, 44 HARV. L. REV. 1222, 1236 (1944) (advocating the “[t]emporary divorce of Is and Ought for purposes of [legal] study”).

²⁸⁴ *Colossians* 1:26.

²⁸⁵ CONWAY MORRIS, *supra* note 249, at 328.

²⁸⁶ See EDWARD O. WILSON, *CONSILIENCE: THE UNITY OF KNOWLEDGE* (1998). I very much intend the phrase “human endeavors informed by science” as a tautology.

²⁸⁷ GOULD, *supra* note 204, at 59.

²⁸⁸ SOLOMON ET AL., *supra* note 37, at 11. See generally J. J. Brocks et al., *Archean Molecular Fossils and the Early Rise of Eukaryotes*, 285 SCI. 1033 (1999); Carl R. Woese & Gary J. Olsen, *Archaeobacterial Phylogeny: Perspectives on the Urkingdoms*, 7 SYS. APPLIED MICROBIOLOGY 161 (1986).

²⁸⁹ See, e.g., BRUCE ALBERTS ET AL., *ESSENTIAL CELL BIOLOGY: AN INTRODUCTION TO THE MOLECULAR BIOLOGY OF THE CELL* 300 (1998); CAMPBELL & REECE, *supra* note 24, at 329–31. For an effort to apply basic microbiology to contemporary questions of national security and constitutional law, see Gil Grantmore, *The Phages of American Law*, 36 U.C. DAVIS L. REV. 455, 488–96 (2003).

²⁹⁰ See Stacy D. Benson et al., *Viral Evolution Revealed by Bacteriophage PRD1 and Human Adenovirus Coat Protein Structures*, 98 CELL 825 (1999).

virus isolated from an archaeal host found in hot springs in Yellowstone National Park.²⁹¹ Structural comparisons of this archaeoviral coat protein with coat proteins of a bacterial and an animal virus suggests that some viruses may have a common ancestor that precedes the divergence of the archaeal, bacterial, and eukaryotic domains of life more than three billion years ago. Within biology, if not cosmology, it is harder to imagine a more staggering story of origins.

To be sure, a story tracing the beginnings of viruses will hardly sway those who deny the common heritage between humans and other animal species, much less the full spectrum of life. But archaeoviruses and their archaean hosts number among the true survivors of natural history. DNA analysis places many extremophiles—namely, species that flourish at some of the highest temperatures and pH extremes known to harbor living organisms—especially hyperthermophilic Archaea, at the base of the universal tree of life, suggesting that thermophiles were among the first forms of life.²⁹² Researchers continue to find extensive biological diversity beneath the sea floor and in other environments traditionally thought too hostile to harbor extensive amounts of life.²⁹³ Insofar as antiabortion activists are fond of saying that “nothing has been added” to the fertilized human ovum “except nutrition,”²⁹⁴ one might defend, with no less rhetorical verve, mi-

²⁹¹ See Stacy D. Benson et al., *Does Common Architecture Reveal a Viral Lineage Spanning All Three Domains of Life?*, 16 *MOLECULAR CELL* 673 (2004); George Rice et al., *The Structure of a Thermophilic Archaeal Virus Shows a Double-Stranded DNA Viral Capsid Type That Spans All Domains of Life*, 101 *PROC. NAT'L ACAD. SCI.* 7716 (2004) (analyzing *Sulfolobus* turreted icosahedral virus, a dsDNA virus of the archaeal host *Sulfolobus sulfataricus*). A veritable wellspring of prokaryotic diversity, Yellowstone is also the source of another thermophilic archaeobacterium, *Thermus aquaticus*, best known as the source of a heat-stable enzyme that facilitates the polymerase chain reaction, a critical process in molecular biology. Thomas D. Brock, *The Value of Basic Research: Discovery of Thermus aquaticus and Other Extreme Thermophiles*, 146 *GENETICS* 1207 (1997); see, e.g., Holly Doremus, *Nature, Knowledge and Profit: The Yellowstone Bioprospecting Controversy and the Core Purposes of America's National Parks*, 26 *ECOLOGY L.Q.* 401 (1999); Carla Mattix, *The Debate Over Bioprospecting on the Public Lands*, 13 *NAT. RES. & ENV'T* 528 (1999); Michael Milstein, *Yellowstone Managers Eye Profits from Hot Microbe*, 264 *SCI.* 655 (1994).

²⁹² See CAMPBELL & REECE, *supra* note 24, at 537 (“Some researchers postulate that the very earliest prokaryotes to evolve were extreme thermophiles that inhabited hot environments similar to deep-sea vents.”).

²⁹³ See, e.g., Linda A. Amaral Zettler et al., *Eukaryotic Diversity in Spain's River of Fire*, 417 *NATURE* 137, 137 (2002) (concluding that the discovery of “wide eukaryotic diversity” in Spain's extremely acidic Rio Tinto, “which has a pH of 2 and contains much higher concentrations of heavy metals than are typically found in fresh waters[.]” “challenge[s] former ideas about the phylogenetic range of organisms that are capable of living in extreme environments”); J. Frederick Grassle, *Deep-Sea Benthic Biodiversity*, 41 *BioSci.* 464, 467 (1991) (estimating perhaps as many as 10 million species of animals on the floor of the deep sea without guessing even to an order of magnitude as to the diversity of bacteria and other microorganisms).

²⁹⁴ See, e.g., Frances Olsen, *The Supreme Court, 1988 Term—Comment: Unraveling Compromise*, 103 *HARV. L. REV.* 105, 128 (1989) (quoting an undated pamphlet called “Did You Know” by J. Willke); Reva Siegel, *Reasoning from the Body: A Historical Perspective on Abortion Regulation and Questions of Equal Protection*, 44 *STAN. L. REV.* 261, 326 (1992) (same).

icrobial accounts of natural history by saying that nothing has been added to primordial thermophiles except evolution.

Although evolutionary biology lacks most “of the trappings of big science”—the grandiose expenditures and breathless reports usually associated with projects such as “the Supercollider or the Human Genome Project or the Hubble Space Telescope”—the questions raised by the phenomenon of extinction across natural history “are every bit as fundamental and interesting in our ongoing attempt to understand our place in the universe and to answer the ultimate question: Why are we here?”²⁹⁵ At once illuminated and unified by evolution, “biology is, perhaps, intellectually the most satisfying and inspiring science.”²⁹⁶ Reinvigorating environmental law with scientific rigor produces its own epiphany, its own spiritually satisfying path toward detecting an “echo of the infinite, a glimpse of its unfathomable process, a hint of the universal law.”²⁹⁷ “[I]ntense spiritual feelings” arise from the “unfathomable complexity and . . . sublime beauty” of the biosphere at its fullest and most diverse.²⁹⁸ Training the law to harness, perchance to halt, the horses of our ecological apocalypse should help us recapture the “beauty and mystery that seized us at the beginning.”²⁹⁹

So too with law. In contemporary secular society, fundamental legal charters represent “sacred symbol[s] of nationhood as well as . . . profane instrument[s] of government.”³⁰⁰ In America, at least, the Constitution “provide[s] the scripture of a national civil religion.”³⁰¹ The preamble to the Constitution speaks of acts that are “sacred as well as secular in character and authority, for we know that ministers are ‘ordained’ and that churches as well as constitutions are ‘established.’”³⁰² Constitutions, religious creeds, and rules of environmental engagement have this much in common: they are all “intended to endure for ages to come, and consequently, to be

²⁹⁵ RAUP, *supra* note 15, at 12–13.

²⁹⁶ Dobzhansky, *supra* note 219, at 129; *see also* SOLOMON ET AL., *supra* note 37, at 368 (“The concept of evolution is the cornerstone of biology because it links all fields of the life sciences into a unified body of knowledge.”). Evolutionary biology and its insights lie at the center of an “emerging third culture” whose scientists and other empiricists, “through their work and expository writing, have taken the place of the traditional intellectual in rendering visible the deeper meanings of our lives . . .” John Brockman, *Introduction: The New Humanists*, in *THE NEW HUMANISTS: SCIENCE AT THE EDGE* 1, 1–2 (John Brockman ed., 2003). This new culture unifies and propels “the new and important ideas that drive our times: . . . molecular biology, genetic engineering, nanotechnology, artificial intelligence, artificial life, chaos theory, massive parallelism . . . superstrings, biodiversity, the human genome, expert systems, punctuated equilibrium, cellular automata, fuzzy logic, virtual reality, cyberspace, and teraflop machines. Among others.” *Id.* at 2. *See generally* JOHN BROCKMAN, *THE THIRD CULTURE: BEYOND THE SCIENTIFIC REVOLUTION* (1995).

²⁹⁷ Oliver Wendell Holmes, *The Path of the Law*, 10 HARV. L. REV. 457, 478 (1897).

²⁹⁸ TAKACS, *supra* note 80, at 255.

²⁹⁹ WILSON, *supra* note 286, at 237.

³⁰⁰ Thomas C. Grey, *The Constitution as Scripture*, 37 STAN. L. REV. 1, 17 (1984).

³⁰¹ *Id.*

³⁰² JAMES BOYD WHITE, *WHEN WORDS LOSE THEIR MEANING* 240 (1984).

adapted to the various crises of human affairs.”³⁰³ Yet today’s environmental philosophies are at once obsolete and insufficiently respectful of natural history and human tradition. Much of the “environmental and land-use ethics” as is “codified in law” stems from an “era when the human population, at one-tenth its present size, tamed wilderness with axe and ox.”³⁰⁴

A “sustainable world will require an ethic that is ultimately as incorporated into culture and as long-lasting as a constitutional bill of rights or as religious commandments.”³⁰⁵ Law and religion are also evolutionary processes;³⁰⁶ they must either adapt to changed conditions or wither away. “Apocalypse does not point to a fiery Armageddon but to the fact that our ignorance and our complacency are coming to an end The exclusivism of there being only one way in which we can be saved, the idea that there is a single religious group that is in sole possession of the truth—that is the world as we know it that must pass away.”³⁰⁷ Within its own domain, environmental law has no time to squander as it tackles the greatest challenge on earth. The failure to take immediate action against biodiversity loss carries the gravest of consequences: the irretrievable loss of life’s diverse pageant. “Ah, where have they gone, the amblers of yesteryear? Where have they gone, those loafing heroes of folk song, those vagabonds who roam from one mill to another and bed down under the stars?”³⁰⁸ Only by tracing “feeling and myth . . . back through time past cultural history to the evolutionary origins of human nature”³⁰⁹ can we recover the magic that bewitched humanity when first it beheld “[e]very contour of the terrain [and] every plant and animal living in it.”³¹⁰ To aspire to anything less casts us on the inexorable and tragic path of “reject[ing] the best the earth could offer.”³¹¹ The Nazarene’s promise to his followers holds true in matters of natural science and human governance as well as matters of faith: “You will know the truth, and the truth will make you free.”³¹²

³⁰³ *McCulloch v. Maryland*, 17 U.S. (4 Wheat.) 316, 415 (1819) (Marshall, C.J.) (discussing the taxation of the Bank of the United States by the state of Maryland).

³⁰⁴ David Tilman, *Causes, Consequences and Ethics of Biodiversity*, 405 *NATURE* 208, 210 (2000).

³⁰⁵ *Id.* at 211.

³⁰⁶ Compare DAVID SLOAN WILSON, *DARWIN’S CATHEDRAL: EVOLUTION, RELIGION AND THE NATURE OF SOCIETY* (2002) with John O. McGinnis, *The Human Constitution and Constitutive Law: A Prolegomenon*, 8 *J. CONTEMP. LEGAL ISSUES* 211 (1997) (describing American constitutional law in evolutionary terms) and John O. McGinnis, *The Original Constitution and Our Origins*, 19 *HARV. J. L. & PUB. POL’Y* 251 (1996) (same).

³⁰⁷ CAMPBELL, *supra* note 241, at 107.

³⁰⁸ KUNDERA, *supra* note 4, at 3.

³⁰⁹ WILSON, *supra* note 276, at 55.

³¹⁰ WILSON, *supra* note 286, at 237.

³¹¹ HAWTHORNE, *supra* note 19, at 281.

³¹² See *John* 8:32.

